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CANAIGRE GROWING IN SOUTHWEST UNITED STATES.

By JOHN E. BENNETT.

FROM present indications the world's supply of tannin is destined shortly to be derived from a new source. What this means to the economic world can be approximated when it is realized that last year 136,284 tons of tanning material were consumed in England alone, while in the United States the consumption was about 1,500,000 tons. These substances comprise mostly oak and hemlock barks, gambier, sumac and their extracts. The uses to which they were devoted was in the tanning of leather, and as leather is one of the most necessary of all human wants, its consumption has been steadily increasing, rising not alone with the increase of the world's population, but through the wider diffusion of civilization and the general growth of prosperity.

With this increase of the demand for leather the accessible supply of tanning substances has not kept pace. The principal sources of these has been the oak and hemlock trees—plants which require about fifteen years to mature sufficiently to permit their barks being peeled without killing the trees, and which are, in fact, rarely so stripped without the tree being entirely cut down and removed from the spot of its growth. There has consequently been much apprehension lest the diminishing supply of the sources of tannic acid should ultimately overcome the tanning industry; and the scientists in numbers have been exploring not alone the domain of plant life, but the zone of chemistry to discover new regions from which tannic acid might be procured.

This has unquestionably at last been found in the Rumex hymenosepalus, or canaigre—the latter word being a corruption of "cana agria," or sour cane, by which the plant is known to the Mexicans. The plant possesses the primary quality of being an annual, being planted and harvested in the crop form, and hence is not a subject of the slow, long-drawn, tedious growth of the tree, which must in the process secrete many times the bulk and weight of that portion of its body required for the specific uses of the tanner.

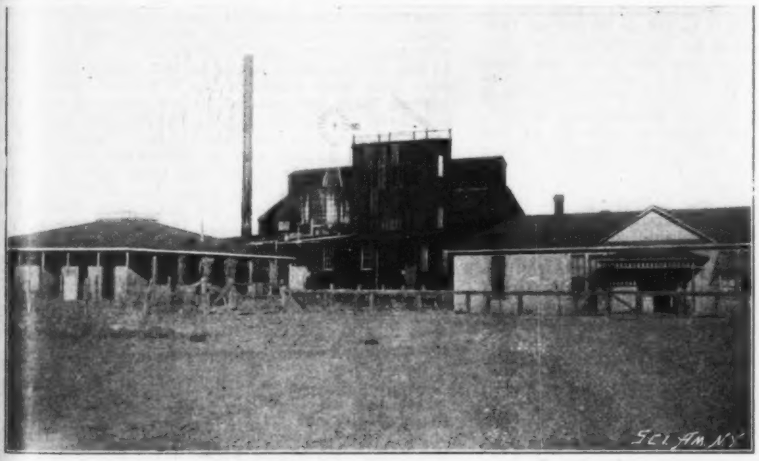
CONTENTS OF TWO HILLS OF GREEN ROOTS.

The canaigre is a bulb or tuber, akin to the potato or the dahlia, growing under cover of the earth and sending up a stalk and mass of leaves to a height of from 15 inches to 3 feet above the surface. It is a remarkable root, even in appearance, and justifies the characterization which the Mexicans have given it of "yerba colorado," or red root. It is indigenous to the arid plains of New Mexico, Arizona and California, extending south into Mexico and Lower California. Here upon long areas it was found wild, its broad spatulated leaves of tender green, with their red midribs and branches making them most conspicuous herbage among the dried or thorny vegetation of the region.

Canaigre has but recently been brought to the attention of the scientific and industrial world, though it has been unquestionably long known to the races of Mexico as a medicine, being used, also, by women to whiten their teeth and harden their gums, and commonly, also, stewed as rhubarb and used as food. The Mexicans employed it in the tanning of leather for saddlery purposes. In 1878 the Agricultural Department of the United States made an analysis of the root, and noting that it contained a large percentage of tannic acid published it as a tanning product of commercial value. A firm of German tanners were induced by a copy of this bulletin to send an expert to New Mexico for the purpose of getting a quantity of the roots. Several car-loads were shipped, but they arrived in a more or less fermented and spoiled condition. Subsequently the roots were sliced and dried, and so shipped to both Germany and Glasgow, Scotland. Shipping in this form was an entire success, provided they were kept dry en route.

Thousands of natives in Mexico and the southwest districts of the United States were turned to gathering these roots from the deserts. The total products shipped to Europe in the chip form may be estimated at no less than 800 car-loads. The roots contain 8 per cent moisture and 35 per cent tannic acid.

The next step was to extract the tannic acid from the roots and ship the extract instead of the roots. A factory was erected by C. B. Allaire at Deming, New Mexico. The extract contained from 42 to 48



THE FIRST CANAIGRE EXTRACT FACTORY, DEMING, NEW MEXICO.

CULTIVATING GROWING CANAIGRE, AFTER IRRIGATION.

CANAIGRE SEEDER PLANTING AND COVERING SEED ROOTS.

MEXICAN INDIANS GATHERING WILD CANAIGRE FROM THE DESERT FOR SEED.

per cent tannic acid. This found a ready sale in Europe. The factory, however, depended on wild roots gathered from the deserts. These were soon exhausted within the radius in which it would pay to team, and when this occurred the factory had to stop.

Up to this time no one had thought of cultivating the roots. There was no precedent for any such agriculture. No one knew anything of the habits and little of the characteristics of the root. The state experimental station at Phœnix, Arizona, set Prof. F. A. Gulley at work on this problem, with the result that several bulletins were issued in 1893 upon the subject. In the World's Fair of that year Prof. Gulley had an exhibit of canaigre, its forms and its products as a tanning agent. The professor received the first medal for tanning products at this exhibit. This produced a decided effect in the tanning world, for it became apparent that henceforth a new agent would supply tannic acid in any quantities that may be desired.

Meanwhile organized capital began to look with an eye to its cultivation as an industry. The Anglo-American Canaigre Company, with Marvel W. Cooper as its first president, and after his decease Andrew McLean as president, started into business to cultivate the roots. It comprised W. B. Carruthers, John H. Carruthers, George W. Speer, John F. Plummer, and George H. Tousey. The company got into working order in December, 1896, with some millions of dollars capital stock, and perhaps nearly a million cash capital. Much English and European money was engaged in the enterprise.

Prior to the start of the operations of this company J. H. Carruthers had planted 1,000 acres of canaigre in the valley of the Salt River, near Phœnix, Arizona. This was a bold venture, for it was a jump in area from the circumscribed patches grown at the experimental station to a ranch proposition of very considerable magnitude. The yield, however, did not disappoint the cultivator and the crop was sold in advance. The Anglo-American Company then procured 8,000 acres in the great San Bernardino Valley of California, near the town of Rialto, and of this 2,000 acres was planted with roots. The product from these acres was used to plant the entire 8,000 acres. The roots when planted are permitted to lie in the ground throughout two years. They are then dug up and the larger roots taken for grinding and the smaller ones used as seed. Much specially devised machinery has been invented by Mr. Carruthers for planting and cultivating the roots.

Although the plant requires a light sandy soil, a wet mild winter and a hot dry summer, yet it thrives by irrigation. The company, therefore, supplemented the winter rains with an extensive system of irrigation works through which water is now conveyed to the plants, with a result that the percentage of tannic acid content is increased in the roots and their deposits of insoluble colors called "reds" is decreased.

In appearance the root is dark red, about 15 inches long. It is punctured with eyes and has brittle heavy bark, is wrapped with a yellowish inner bark and has a ring of yellow coloring matter about its core. Its flesh is pink and astringent to the taste. It sends up broad, smooth, light green, usually wavy margined leaves, spreading at the surface of the ground, attaining a length of 20 inches. It has a stout stem 3 feet high, blossoming in pink flowers upon compound branches which yield about 1,000 seed, brown when ripe and somewhat resembling the seed of buckwheat.

As soon as the entire 8,000 acres are in a condition to harvest the company will erect an extracting factory and the harvesting of two 3,000-acre lots will begin, it being designed to keep the factory running at all times. To this company is due the credit for having taken a wild and little known root and developing it into a standard article of commerce and a recognized factor in the tanning world.

SCHOOL GARDENS IN SWEDEN.

The largest nursery in Sweden is the so-called experiment ground, near Stockholm, belonging to the Royal Academy of Agriculture. There are many others, however, in the southern and central provinces, also in the northern part of the kingdom, as far north, indeed, as Lulea (nearly 66 deg. north latitude). The methods employed in propagating trees and shrubbery are the same as in other countries. The process of development which gardening in Sweden has undergone of late years is to be attributed in a large measure to the encouraging example of a number of large estate owners, and to the interest taken in the subject by the government, agricultural societies, and private associations. Besides the two important botanical gardens at Upsala and Luna, which are more especially intended for academic tuition, there are the experiment grounds of the Royal Academy of Agriculture, where many park and fruit trees and ornamental shrubs are grown. The United States Consul-General at Stockholm says that the school for gardeners at the experiment grounds of the Royal Academy of Agriculture and the school of the Swedish Horticultural Society are the chief educational institutions devoted to agriculture in the kingdom. Instruction in gardening is also imparted at the Bergius Gardens, near Stockholm, at the agricultural high schools of Ultuna, and Alnarp, and at the schools of agriculture distributed over the whole kingdom; all the institutions being under the control of the Royal Academy of Agriculture. The firmest basis for the branch of culture lies, however, in its being made a subject of national education. Gardening is taught at the seminaries for national school teachers, and at the national schools in the kingdom school gardens have been established. The different parishes must grant the necessary ground for these gardens, which contain the usual culinary herbs, a few medical plants, an arboretum, etc. The children are taught the best methods of gardening, and each year they receive trees and shrubs to plant at their own homes. The agricultural societies employ so-called "master gardeners of the province," who aid the public with advice and information. Horticultural societies, to the number of about twenty, are spread all over the kingdom, and are active in promoting exhibits, printing and distributing publications, imparting instruction, and supplying plants and seeds.

GEOLOGY AND GEOGRAPHY AT THE DENVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

By E. O. Hovey.

Although there were only twenty-three papers presented to the section of geology and geography of the American Association for the Advancement of Science at the meeting in Denver during the last week in August, and but seven were offered to the Geological Society of America, which met on one of the days, the convention was characterized by the attendance of some of the best geologists in the country, a large number of outsiders was present, the papers read were of a high order of merit and interest, and the discussions were animated and valuable. There was no annual address by the chairman of the section this year on account of the new rule now going into effect throughout the association by which the vice-presidents are to give their addresses as they retire from office, instead of at the meetings when they are actively in administration. One of the most important papers of the whole convention was the public lecture by C. R. Van Hise, of the University of Wisconsin, on the subject, "A Study of Ore Deposits," a topic in which a very large proportion of the citizens of Denver and Colorado in general are vitally interested.

Prof. Van Hise gave the public the results of his years of study of the alteration of rocks in their necessary effect upon the solution of problems connected with the origin of the deposits of metallic ores. For many years ore deposits have been classified into those which are produced (1) by the direct action of igneous agencies, (2) by the process of sedimentation, (3) by the action of underground water. The difference of opinion arises as to the relative importance of these different processes. It is the author's contention that the greater number of valuable ore deposits belong to the last class; that is, that the waters which permeate the rocks everywhere for a considerable depth below the surface of the earth are taking material into solution in one place or region and are depositing it in another, and that the material thus deposited in certain places is sufficiently abundant to make an ore deposit. The places where the work of these underground waters is most effective is, of course, the larger cracks and crevices, since these are the planes of least resistance. The next fundamental principle is that the ores are derived from the outer crust of the earth. At a certain depth below the surface of the earth the superincumbent weight will be sufficient to overcome the crushing strength of the most resistent rocks. Hence, openings of great size cannot be assumed to exist below this depth. If this be so and we admit that ore deposits are placed where they are by underground water, then the process of gathering and depositing the ores must be confined to the outer few miles of the crust of the earth, which is called the zone of fracture. It has been determined by calculation that the small amount of metallic materials in this outer crust is enough in sum total to account many times over for all the deposits which have been or are likely to be mined. There are cases in which ore deposits have probably been produced directly by igneous action, such as the titaniferous iron ores of the Adirondack Mountains and certain other ores, as tin ore; but it is yet to be proven that the great mass of ores, such as the oxidized ores, the carbonates, the sulphides or the tellurides, owe their origin to this cause. The author holds that in the great majority of cases the ores have been leached from the igneous rocks by the underground waters, have been carried to their present positions by the underground waters and have been deposited there by the underground waters. The circulation of the waters is due to the expansion of the lower portion by subterranean heat and the subsequent action of gravity. Where underground currents come together, each charged with different metallic solutions, chemical precipitation makes a rich ore, forming cross-veins or pockets. Prof. Van Hise concluded his address by proposing a new classification of ore deposits: (1) Ores which have been concentrated by ascending water alone; (2) those which have been concentrated by descending waters alone; (3) those which have been concentrated by ascending waters and reconcentrated by descending waters.

The most important paper from a theoretic point of view was that by T. C. Chamberlin, of Chicago University, which was entitled "Report on Some Studies Relative to Primal Questions in Geology," and gave the present results of investigations which have been carried on for the past ten years. At the outset the author was a conservative adherent of the nebular hypothesis of Laplace and others, but he was led to undertake the present investigation on account of the conflicting theories which have been adopted by geologists from time to time to explain really related problems. The inquiry has been along the lines of the laws of mass and momentum, the mathematical portion of the study being carried on in conjunction with Dr. Moulton. According to the Laplacean hypothesis the planets were thrown off in turn by the revolving nebula, but the laws of mass and momentum show that Jupiter alone, which has less than one-one thousandth of the total mass of the solar system would have used up 95 per cent of its whole original energy, which seems to be an untenable conclusion. Again, the periphery of the solar system contains 1-700th of the mass, but has 97 per cent of the energy, which is another untenable result. These and other arguments lead to the conclusions that Laplace reasoned from incorrect data and that his nebular hypothesis must be abandoned.

The theory that the earth has been formed by the assembling of meteorites also seems to be untenable. But what is the origin of meteorites? Some are hydrocarbons, and can never have been subjected to high temperatures; some are stony and brecciated, faulted and veined; and all show the action of the same forces as the earth. Their composition shows that they cannot have come from volcanic eruptions on sun or moon. When a small body in traversing its orbit passes by a large body it is liable to suffer disruption, and the fragments would not be subjected to great heat. Comets are bodies which act thus and seem to be a reasonable source of meteorites. Temporary stars may be due to the disruption of planets with luminosity induced in the main portion. By means of a diagram Prof. Chamberlain showed the effect upon a gaseous, or nebular, body of coming within and passing through the zone of disruption of a solid body. The gaseous mass will explode as it passes the nearest point to the solid body, and its fragments will continue their journey with a spiral or vortical motion. Recent astronomical discoveries by Keeler show that the present number of nebulæ is between 100,000 and 120,000, instead of 8,000 to 10,000 as formerly supposed, and that most of these are spiral in character. The author and his colleague have come to the conclusion that such an exploding nebula with resulting vortical motion in the fragments was the most probable origin of the solar system, the planets being due to the slow aggregation of the attenuated matter of these fragments, with the accompaniment of relatively low temperatures. According to this theory the earth is solid and, in fact, we must revise most of our old theories, if this new hypothesis be true.

C. R. Van Hise gave the Geological Society of America a brief reference to the ten-day excursion through the mountains of Colorado before the meeting and took occasion to lay special stress upon the importance to all working geologists of attending such excursions as a means of extending their knowledge and broadening their ideas. U. S. Grant, of Northwestern University, gave a short description of the junction of the Lake Superior sandstone and the Keweenawan traps in Wisconsin, in the region south and southeast of Superior City. This sandstone, which is brecciated in character with very small fragments, overlies the Keweenawan sandstone and is much thicker than was supposed to be the case from the section studied by Irving and Chamberlin farther east. It does not seem to be affected by the Lake Superior syncline.

In giving a sketch of the hydrographic history of South Dakota James E. Todd, the state geologist of that state, presented to the society general conclusions which had been reached after personal examination of nearly all the streams mentioned. He said in part that the Eocene, or possibly the later Laramie, was the first to launch streams which continue to the present. The Little Missouri, Upper Belle Fourche, Upper French Creek and a few less important rivers may have originated then. The middle tertiary age lengthened the same streams and gave a more decided eastward tilt to the central portion of the state till the great tertiary Lake Cheyenne had been filled and drained. With the later tertiary time most of our present streams began to have recognizable form. The Pre-Wisconsin Pleistocene age witnessed great increase in volume in these streams on account of abundant rainfall and from the melting of the adjacent continental ice sheet which had not yet overridden the divide in eastern Dakota. These copious floods assisted in deporting large portions of the loess, and later deeply eroded the James-Missouri Valley, and some of its western tributaries, the Cheyenne beheading the Bad and White Rivers. The Wisconsin epoch witnessed the occupation of the James Valley by the ice sheet, the beginning of the present Missouri through the state, the cutting of a new course also from Bon Homme to Yankton, the turning of the Big Sioux over into the Split Rock and finally into Rock Creek. Several peripheral streams and interlobular streams, as they may be called from their relations to the glacier, were begun at this stage, though more date from later stages of the Wisconsin epoch.

Prof. Todd has noticed in his study of the glacial moraines of eastern South Dakota, particularly the later moraines in the James River Valley, that they are wider, rougher and at somewhat lower altitude upon the west side of the loop than upon the eastern. The explanation of this which the author offered to the association is that the maximum diurnal temperature occurs some time in the afternoon, hence the western side of an ice lobe will receive more heat than the eastern, and will consequently move faster, bring forward more débris, melt more rapidly and be more apt to detach and bury blocks of ice. In the northern hemisphere the southern side of an east or west flowing glacier will exhibit similar phenomena for a similar reason.

The use of artesian wells has spread throughout eastern South Dakota very greatly during recent years, which has led to much study of such wells by the State Geological Survey. Prof. Todd detailed the chief unsolved questions which have arisen regarding the wells. He passed with simple mention, however, the questions of the exact source of the waters and the rate of eastward leakage, because of the small progress made toward their solution. The artesian system shows four or five aquifers or water-bearing strata which are more or less completely separated from each other; and the first problem is: How is this separation accomplished? Is it by sheets of clay wholly, or is it in part due to mutual precipitates between two qualities of water? Artesian waters may be divided quite sharply into soft, or soda-bearing, and hard, or lime-bearing, and both kinds are found in the same aquifer in different localities. Hence, what dominates the mineral content of the water at any place? If it is the content of the rock where found, as seems most probable, there can be little hope of getting light on its source by an analysis of water from streams and wells. The subterranean flow seems to be from the southeast, but the soft waters in each aquifer are found to the northwest or down-stream side, while the hard waters, which contain the less soluble salts, are found to the southeast. Again, what is the origin of the natural gas which impregnates the waters, especially from the lower aquifers about Pierre along a line extending north and south for fifty miles and over an area reaching indefinitely toward the west. There are reasons for believing that there may have been extensive carbonaceous deposits in the carboniferous rocks a little west of Pierre, the eastern edge of which is overlain directly by the Dakota formation in which the waters occur. Subterranean heat may have distilled the gas into the overlying water stratum, carrying the higher temperature and perhaps adding to it by condensation. A few miles east of Pierre the gas disappears and the temperature of the water declines in marked degree. What becomes of the gas?

* Specially reported for the Scientific American Supplement.

The readiest suggestion is that the gas escapes from the water to the surface by its greater penetrating power, but no gas springs have been found, and only a little at higher levels by boring shallow wells. The last problem is the high temperature of the water from some of the wells.

T. C. Chamberlin, in a communication on stoping as a means of forming terraces, said in brief that the Chippewa River, of Wisconsin, showed four systems of terraces separated by rock barriers. Glacial Lake Agassiz, in the Dakotas and Minnesota, showed four systems of beaches, so also does glacial Lake Chicago. Stope-cutting makes the sudden or comparatively sudden transition from one level to another on cutting through resistent material.

E. H. Barbour, of Nebraska State University, contributed a paper on the "Distribution of Daemonelix, or Devil's Corkscrew," in which he said that these strange-looking fossils had been first found in 1891, and were then supposed to be confined to Sioux County in northwestern Nebraska. Now, however, masses of small rootlets are known to occur all over an area of about 500 square miles, with a few widely separated localities, notably Lusk, Wyo., and the Sioux Reservation in South Dakota, where typical individuals have been found.

Local geology naturally received considerable attention at the meeting. S. T. Lee, of Trinidad, Colo., described the areal geology of the Castle Rock region, which lies just to the south of the Denver basin. The ages represented run from the pre-cambrian to the tertiary, with remarkable apparent thickness of the cretaceous beds. The author thinks that a large portion of this apparent thickness is due to mechanical deformation of the beds. Prof. H. B. Patton, of the Colorado School of Mines, read a paper summarizing the work which has been done on the region in the vicinity of Golden, twelve miles west of Denver. Mr. G. L. Cannon, of Denver, presented the "Problems of the Quaternary Deposits of South Platte Valley." These two papers had special bearing upon the geological excursions in and near the city which were taken on three afternoons of the week under the leadership of these two gentlemen.

"The Geological Occurrence of Oil in Colorado" was the title of a paper by A. Lakes, of Denver, in which was brought together the information obtained by recent boring within the borders of the state. Until within a year the small field at Florence, near Cañon City, has been the only productive one and its horizon has been supposed to be the only oil-bearing bed in Colorado. Now, however, it is known that petroleum is widely distributed over the state, and that its signs are to be found in at least six geological horizons. Beginning with the lowest these are, the upper carboniferous strata, in the Rio Blanco basin of Archuleta County; the upper jurassic on Oil Creek, near Cañon City; the Dakota cretaceous sandstones on Turkey Creek, near Golden, in the Denver basin; the Niobrara cretaceous limestone at Pagosa Springs in Archuleta County; the Montana cretaceous shales at Florence, in the Denver basin, and in Archuleta, Routt and Boulder counties; the Wahsatch tertiary series of the book cliffs in the northwestern part of the state. To these may be added the basaltic dikes in Archuleta County and the Huerfano district, which are charged with liquid bitumen derived from undetermined horizons. These facts justify Coloradoans in hoping for a successful oil-field within their state—a hope which was strengthened during the week of the association meeting by the striking of a highly promising well at Boulder.

In the discussion following the reading of Mr. Lakes' paper Prof. Patton spoke of a small flowing oil spring which issues from Archæan rocks in a gulch above Golden, Colo., three-quarters of a mile from the contact with the sedimentary beds and one and a quarter mile distant from the nearest known oil in those beds. This is the only instance known of such a spring in the Archæan, and the oil may come up through a fissure cutting the sedimentaries at a great depth.

G. H. Stone, of Colorado Springs, in a note on the minerals associated with copper in southeastern Arizona and southwestern New Mexico stated that, while the copper-bearing veins of the region are substantially like those of the states northward in respect to the kinds of copper compounds and the occurrence of quartz and the hydrous gangue minerals, they are remarkable for the anhydrous silicates which they contain. One of the common gangue minerals is pyroxene in slender prismatic crystals, tablets and asbestos. Epidote occurs frequently as incrustations and as the filling of veinlets and small rounded cavities in the limestones and in the porphyries which cut them, but in the California mining district in the Chiricahua Mountains there are several exposures of granular epidote forming the filling of a vein three to five feet wide. By far the most abundant of these anhydrous gangue minerals is garnet. The copper ores are usually found beside granular masses of garnet but sometimes are distributed through the garnet mass also. Sometimes the garnets occur isolated in the limestone, but more often they are massed together in bodies which are surrounded by limestone, proving that the latter was replaced by the garnet. In the Chiricahua Mountains the limestones along the copper veins have been largely replaced by garnet to a breadth of 10 to 50 feet or more, while in the Dragoon Mountains the author saw belts of limestone which for a breadth of at least 600 feet showed a fourth as much garnet as limestone. The southern portion of Santa Fe County, New Mexico, seems to be the northern limit of these large bodies of garnet. Mr. Stone also read a paper dealing with the extinct glaciers of New Mexico and Arizona, in which he gave his reasons for not believing them to have been as extensive or as numerous as has been thought. Cloudbursts carry boulders up to 10 and even 15 feet in diameter considerable distances and pile them up in such a way as to make a newcomer think at first that he has to deal with glacial moraines. True moraines have not been found below an altitude of 8,000 feet.

A. C. Lawson, of the University of California, read a paper on the "Oscillations of the Coast Ranges of California," in which he described in brief the topographic history of that part of the Pacific Coast and showed that there had been four periods of depression of the region west of the Great Valley of California, followed by as many periods of emergence and erosion. The Great Valley has always been a valley since it was first formed, and has been the "hinge" on which the oscillations of the coast ranges have taken place.

C. R. Eastman, of Harvard University, gave a comparative review of certain palæozoic sharks for the purpose of showing that the coiled, serrate fossil which was recently described by A. Karpinsky from the carboniferous beds of Russia and called an exterior organ of defense like the sword of a swordfish, was really a modification of the teeth and had its place within the mouth.

T. A. Rickard, of Denver, made an earnest "Plea for Greater Simplicity in the Language of Science" which struck a very responsive chord in the minds of all his hearers. The scope of his paper is well indicated in its title, and the author illustrated his theme by well-chosen examples of the use of language "which obscures truth and falseness alike to the degradation of science and the total confusion of those of the unlearned who are searching after information." The author strongly urged, in conclusion, that such technical terms as are considered essential should not be used carelessly, and that in the publications intended for an untechnical public, such as most government reports, an effort be made to avoid them and that, where they are unavoidable, those least likely to be understood be translated in foot notes.

In a "Note on Certain Copper Minerals" A N. Winchell, of Butte, Montana, described the formation of chalcopyrite and bormite in the iron rails of a smelter in that city. The former mineral had been reported before under these circumstances, but not the latter. These minerals replace the iron of the rails so rapidly, every part being affected except that embedded in the wood of the ties, that new ones have to be put in every eight or ten months.

W. G. Tight, of Albuquerque, New Mexico, read a paper entitled "Interpretation of Some Drainage Changes in Southwestern Ohio," which embodied some of the results of more than ten years' study of that region. The author contends that the present river valleys there date from interglacial time, and that ice-damming had very little to do with the present courses of the streams, while gradual silting up has had much to do with them.

A. H. Purdue, of the University of Arkansas, described the physiography of the Boston Mountains, which lie in the northwestern part of Arkansas and constitute the highest portion of the Ozark Mountains. The rocks of the region are mainly sandstones and shales, those at the base being of lower carboniferous age, while those at the top belong to the coal measure series. The alternating hard and soft beds have produced the terraces of the hill slopes which are so characteristic of elevated regions of horizontal strata. The stage of the drainage is that intermediate between youth and maturity. The streams are vigorous and have completely dissected the plateau by the formation of gorges from 500 to 1,000 feet deep, producing a very rugged topography. Between these gorges the slopes often meet, forming more or less rounded hills, but more frequently the intervening area is occupied by flat-topped sandstone-capped hills of limited extent. The elevation of the region must have taken place in late tertiary or in post-tertiary times and was greatest along the present eastward axis of the plateau, gradually diminishing toward the north.

In a paper on the minerals and mineral localities of Texas, F. W. Simonds, of the University of Texas, stated that 150 mineral species are now known to have been found in Texas, of which 25 or 30, mostly those containing the rare earths, have been found at the Barringer Mound. Only ten minerals of economic importance have been reported, viz., petroleum from 21 counties, limonite from 23 counties, coal, hematite, magnetite, salt, gypsum, asphalt, gold, and silver.

Certain sandstone intrusions associated with the asphalt-bearing deposits near Santa Cruz, Cal., were described by J. F. Newsome and J. C. Brauner, of Stanford University, with the aid of numerous stereopticon illustrations.

One geological paper was read before the section of Social and Economic Science by C. W. Comstock, of the Colorado School of Mines. It was on the "Development of the Mineral Resources of Colorado," and showed in the first place the state's leading position in the mineral-producing world, especially in regard to gold and silver. A few years ago 49 per cent of the state's production was silver and 35 per cent gold; last year the ratio was 25 per cent silver and 57 per cent gold. The all-important point in the production of the precious metals is the increased economy in the mining and treatment of ores. This is indicated by the lower grade of ore mined now as compared with earlier years. The causes leading to these reductions are cheaper labor, cheaper fuel, lower freight rates, cleaner work and closer attention to details. One of the potent factors in developing low-grade ores has been the improvement in ore-dressing machinery and methods, together with a wider dissemination of information in regard to them. The figures from one instance of actual practice show that proper mechanical preparation has made a change from a loss of $5 per ton to a profit of $2 per ton.

The officers of the section were: C. R. Van Hise, vice-president, and H. B. Patton, secretary; for the ensuing year they are O. A. Derby, of Sao Paulo, Brazil, and F. P. Gulliver, of Southboro, Mass., respectively.

AUSTRALIAN GEM STONES.

CONSIDERABLE quantities of sapphires, rubies, emeralds, and other gem stones have been found in Australia during the last few years, and although there have been comparatively few of commercial value, their abundance naturally leads to the assumption that in the near future discoveries of a superior class of stones will be made. In New South Wales sapphires are found in many places, mostly in alluvial deposits containing gold and tin; but it is only in a few instances that the stones possess sufficiently good color to render them valuable as gems; the majority of the sapphires having a greenish-blue or bottle-green tint, while most of those which are pure blue by transmitted light are of such a deep shade that they appear almost black when seen by reflected light. Sapphires of indifferent quality are especially numerous a few miles to the east of Inverell, in the northern part of the state, so much so that the name Sapphire has been given to the locality. Rubies are frequently met with but specimens of the oriental, or true ruby, are somewhat rare. It is possible, however, that crystals of sufficient size and purity to be commercially valuable may yet be discovered. The topaz is found in many places in New South Wales, especially in the northern elevated regions. Here, near Emmaville, fine colorless transparent crystals were found associated with emerald, beryl, fluorspar, mispickel, kaolin, and tinstone in a pegmatite dyke traversing indurated claystones. Many of the topazes have a beautiful pale blue color and are of large size. Professor Liversidge states that a portion of a large bluish-green crystal found at Mudgee, in the western district, weighed several pounds; also that one found at Gundagai, in the south, of a pale blue-green tint, measured three by one and a half inches, and weighed 11 ounces 5 pennyweight, while another of a similar color from Gulgong weighed 18 ounces avoirdupois. The New South Wales emerald mining industry dates from 1890, when a rich deposit was discovered at Emmaville, and 2,225 carats forwarded as a trial shipment to London, some of the gems realizing £4 per carat. About 50,000 carats were obtained during the next two years, but the hardness of the matrix in which the emeralds were found proved a source of considerable difficulty, it being almost impossible to break down the rock without injuring and frequently destroying the stones. In this way, it is asserted, many of the finest and most valuable specimens have been lost. The somewhat inferior character of later shipments to London caused them to prove unremunerative, and during the next few years mining operations became suspended. These have since been resumed, and it is anticipated that in due course deposits of richer quality will be reached. Turquoise has recently been discovered in the coastal region south of Sydney. It occurs chiefly as twin veins, from one-sixteenth to nearly one-quarter of an inch in thickness in the joints of the slate. The color of most of the mineral hitherto found is not sufficiently good to render it marketable, being of a bluish-green instead of the sky-blue which makes turquoise a highly-prized gem. Some of the stones, however, are of fair color, and lend encouragement to the hope that further prospecting may result in the discovery of more valuable material. Zircons of small size are extremely common in the auriferous and stanniferous gravels in different parts of the state, but large stones are comparatively rare. The beach sands of the northern coast, which contain platinum and tin, are largely composed of minute grains or crystals of zircon. The largest specimens of this mineral are found in the neighborhood of Hanging Rock (Nundle); they are colorless and transparent, and possess such a fine luster that the gold-miners have frequently mistaken them for diamonds. Garnets also are of common occurrence in many parts of the state, and they vary in size from minute grains to crystals of one inch or more in diameter; but stones suitable for cutting and polishing as gems appear to be rare, and so far they have not been regarded as of commercial importance. Other stones found in New South Wales include the opal, amethyst, chrysolite, cairngorm, and onyx; in fact, almost every kind of known gem stone is believed to exist in the state, but the absence of surface indications acts as a check upon systematic prospecting. In "The Mineral Resources of New South Wales," published by the State Government, are given a number of plans and views of the localities in which diamonds and other leading gem stones are found, which may interest those connected with the industry.

AUSTRALIAN OPAL AND OPAL MINING.

By JOHN PLUMMER.

CONSIDERABLE quantities of opal are found in Queensland and New South Wales. In the latter state the commoner kinds are found in many localities, especially in the neighborhod of Orange, but they possess little or no commercial value. Precious or noble opal is obtained principally at White Cliffs, in the dry western country, about 780 miles from Sydney and 65 miles from Wilcannia. The latter township is about 100 miles from Broken Hill, and the whole country is said to be rich in minerals, but the deficient water supply seriously retards the efforts of prospectors. According to Mr. E. F. Pittman, in his work on "The Mineral Resources of New South Wales," the precious opals of White Cliffs, as in the case of many other valuable mineral deposits, were discovered by accident. In 1889 a hunter, while tracking a wounded kangaroo, picked up a piece of the brilliantly colored mineral on the surface; after the find had been reported, a careful search of the locality was made, with the result that several more pieces were discovered; prospecting trenches were then excavated, and the gem was found in situ. Since that time mining operations have been carried on continuously, though sometimes under great difficulties, as in time of drought the locality is very badly provided with water; opal mining has, however, now become a settled industry, and a thriving township has been established at White Cliffs. The area within which the mineral has been found in the district is about fifteen miles long by about two miles wide. Prospecting for precious opal is a decidedly hazardous business, because, as a rule, there are no indications whatever on the surface of the occurrence of the mineral below. It is only in very rare instances that an outcrop of the gem can be seen, and the usual procedure is to dig a trench or pit in such a position as fancy may dictate, and trust to luck. Fortunately, sinking is easy, as the rock is of a soft nature, and, in a fair number of instances, the opal has been met with at a very short distance from the surface, though a large majority of the pits are unsuccessful. For several years the belief existed among the miners that it was useless to prospect for precious opal at a greater depth than twelve feet from the surface; but of late the incorrectness of this view has been proved, and the stones have been discovered at a depth of nearly fifty feet. According to an authority quoted by Mr. Pittman, there is a wonderful variety of opal found on the field, and the prices paid locally run from zero to $125 per ounce, the ounce being the unit for purchasing in the rough. It is

rarely that the price paid exceeds $100 per ounce. In valuing opal a good many points have to be taken into account. Needless to say, color is the first, red fire, or red in combination with yellow, blue and green being the best. Blue by itself is quite valueless, and green opal is not of great value, unless the color is very livid, and the pattern good. That the color should be true is a vital point. However good it may be, if it runs in streaks or patches, alternating with colorless or inferior quality that is untrue, it is of comparatively small value. Pattern is an important factor in the value, the various kinds being distinguished respectively as "pinfire," when the grain, if it may so be called, is very small; "harlequin," when the color is all in small squares, the more regular the better; and "flashfire," or "flash opal," when the color shows as a single flash, or in very large pattern. Of course, there are many intermediate classes. The harlequin is the most uncommon and also the most beautiful. When the squares of color are regular and show as distinct minute checkers of red, yellow, blue and green, this class of opal is truly magnificent. The flash opal is often very beautiful in color, especially when of the true ruby or pigeon's blood color. As a rule, however, it shows green or red flash according to the angle at which it is held. The direction of the pattern has also to be considered. Often a stone that shows a very good edge pattern will not look nearly so well on the face, while a stone which shows somewhat streaky in the shorter direction on the edge will sometimes give a fine harlequin pattern on the face. On this account the shape of the stone comes into the reckoning. Thus, a thick stone, with a good edge pattern, may often be cut up, so as to use that pattern as a face to all the stones cut from it; while a thin stone, though of equally good edge pattern, which could only be cut with the natural face, would probably not be worth nearly as much, weight for weight. It is difficult to obtain separate stones of absolute similarity in color and pattern; therefore, for suites of jewelry, a large, true stone, from which the whole could be cut, is worth a great deal more per ounce than so many smaller stones, approximately similar. Again, the ground or body of the opal must be taken into account. This is not a constant quantity, as the various patterns require slightly different ground. It should neither be too transparent nor too opaque, almost clear, with a slight milky tinge, translucent being about the best ground in general. Some of the opal is more brittle than others. Of course, the harder and tougher the stone the better it is, as, when cut, it is less likely to be injured, and retains the polish better. Many valuable opals have been found from time to time, one, weighing about four and a half ounces, being sold by the finder for $500. Of course, in London it would bring a considerably higher price. Another opal, weighing nine ounces, was accidentally broken in two, the pieces weighing seven and two ounces respectively, and was valued locally at $3,500. The value of the opal obtained since the discovery of the deposits in 1889 to the end of 1899 is estimated at $1,882,995, but much of the opal obtained is not officially reported.

THE FOOD OF NESTLING BIRDS—BLUEBIRDS, ROBINS, AND HOUSE WRENS.*

By SYLVESTER D. JUDD, Ph.D., Assistant Biologist, Biological Survey.

GENERAL REMARKS.—The amount of food consumed by nestling birds is not generally appreciated. The number of broods and of young vary according to the species and the region under consideration, but it is safe to say that on the average 2 or 3 broods of 3 to 5 each are raised every season. The young, from the time the eggs are hatched until the last offspring has left the nest, demand the most constant and untiring industry on the part of the parents. The labor of feeding begins before sunrise and continues with little rest until after sunset. Meals are very frequent, often averaging one every two minutes. At first the nestlings consume more than their own weight of food in a day, and make a daily gain in weight of 20 to 50 per cent. At this time they appear to consist of little else than mouth and stomach, and spend nearly all their waking moments in eating. The total of the material required to satisfy their voracity is astonishingly large. A young robin kept in captivity by Prof. Treadwell required 60 earthworms a day, and the young of a pair of European jays, observed by Dr. Brewer, were fed half a million caterpillars in a single season. The character of the food consumed in such quantity by different species of nestlings, apart from its scientific interest, is of great importance to the farmer, since many nests are placed in proximity to growing crops and the nesting season corresponds with the period of greatest agricultural activity.

Species of birds having a homogeneous diet, either animal or vegetable, rear their young upon food similar to that which they themselves take. Thus, gulls, terns, pelicans, herons, kingfishers, and the like piscivorous birds, bring up their broods principally on fish; truly raptorial birds, such as hawks and owls, feed their young on birds and mammals; exclusively insectivorous birds, such as cuckoos and swallows, feed nothing but insects; and exclusively granivorous birds, such as doves and pigeons, feed only starchy seed materials. But birds that subsist on both animal and vegetable matter usually feed their young almost entirely on insects, chiefly such injurious kinds as grasshoppers and cutworms. Many of our common birds are comprised in this class.

FIG. 1.—BLUEBIRD AT EDGE OF NEST WITH GRASSHOPPER IN MOUTH.

FROM PHOTOGRAPH BY REV. P. B. PEABODY.

Seed-eating birds and those that subsist on a mixed animal and vegetable diet, composed largely of hard material, have powerful muscular grinding gizzards, for food of this kind resists digestion and requires to be broken up in the stomach; but birds which live on insects or vertebrates that are soft and easily digested have thin-walled, comparatively weak, nonmuscular stomachs. These anatomical peculiarities and consequent differences of function must not be lost sight of in the study of the food of young birds, for they are responsible for marked differences of diet as maturity is approached. Whatever may be the character of the parents' stomach structure, however, the stomach of a newly-hatched nestling is in most cases merely a membraneous sac with comparatively little muscular development, and cannot assimilate anything but the softest, most readily digestible material. Therefore in the case of many species the food of the young must differ radically from that of the adult. Such grain-eating birds as pigeons, possessed of strong gizzards, feed their squabs on the so-called "pigeon's milk," which is digested grain of semi-fluid consistency, disgorged by the parent bird into the gullet of its offspring. Many birds that are largely vegetarians, but not endowed with this power of regurgitating digested food, rear their young for a time on insects. The crow blackbird, whose annual food is three-fourths vegetable matter, will serve as an illustration: The first meal of the nestlings often consists of plump spiders of soft texture, which suit the delicate embryonic stomach; and these, together with tiny young grasshopper nymphs and soft small cutworms, continue for a while to form the food. As the stomach develops, however, the diet changes; such hard insects as beetles soon become a part of the fare, and by the time the young blackbirds are nearly or quite half grown their stomachs are strong enough to digest corn. Corn is then given to them freely, and in increasing quantity, until, when they are ready to leave the nest, it forms about one-quarter of their food.

FIG. 2.—NESTLING CROWS.

FROM PHOTOGRAPH BY REV. P. B. PEABODY.

In the following study of the food of nestlings of the various kinds of birds each group is taken up separately. The material has been gathered from detailed field observations by the writer and others and from examination of the contents of the stomachs of 700 nestlings.

BLUEBIRD.

The food of 6 feathered nestling bluebirds (*Sialia sialis*), the stomachs of which were examined in the laboratory, consisted of beetles, caterpillars, grasshoppers, spiders, and a few snails. Adult birds collected during the breeding season had eaten about three times as many beetles and a few ants, while 8 per cent of the food consisted of black raspberries.

ROBIN.

The robin (*Merula migratoria*) is about as troublesome to the horticulturist as are the catbird and cedar waxwing. Prof. F. E. L. Beal found that young nestlings, watched for several hours, were fed from five to six times an hour. Subsequent examination of the stomachs of 14 of these nestlings and of 8 of their parents showed that raspberries, blackberries, blueberries, cherries, and serviceberries formed only 7 per cent of the food of the young, while it formed 70 per cent of that of the old birds. In the case of the young, many of the stomachs contained pellets of grass, one in each stomach, the significance of which is not yet clear. The insect food of the young consisted chiefly of caterpillars, locusts (Locustidæ), grasshoppers, crickets, and beetles (carabid beetles, May-beetles, and their larvæ). Spiders, snails, and earthworms were present in smaller quantities.

HOUSE WREN.

The house wren (*Troglodytes aëdon*) is exclusively insectivorous, and is one of the most useful birds on the farm. That nestlings are fed very frequently and consume an enormous quantity of food is well shown by a half day's observation made by the writer at Marshall Hall, Md., on June 17, 1899, of the feeding of a brood of three. The family was found housed in a cavity in a locust tree, and was transferred to a baking-powder can, which was nailed to the trunk of the tree four feet above the ground, a convenient height for observation. The young were about three-fourths grown. The following is a detailed account of the feeding.

FEEDING OF A BROOD OF HOUSE WRENS.

A. M.	
5:55.	Green caterpillar (*Heliothis dipsaccus*).
5:56.	May-fly.
6:00.	May-fly.
6:02.	Undetermined.
6:05.	*Heliothis dipsaccus*.
(Observations suspended till 7:20 A. M.)	
7:21.	Undetermined.
7:23.	May-fly.
(Observations suspended till 7:45 A. M.)	
7:46.	Harvest-man (Phalangidæ).
7:47.	May-fly.
7:48.	Undetermined insect.
7:49.	Undetermined.
7:51.	Undetermined.
7:55.	Undetermined.
7:56.	Undetermined.
7:57.	Undetermined.
7:57½.	Undetermined.
8:00½.	Undetermined.
8:01.	Undetermined.
8:03.	Undetermined.
8:03½.	Undetermined.
8:06.	*Heliothis dipsaccus*.
8:08.	Undetermined insect.
8:11.	Undetermined insect.
8:13½.	Brown caterpillar.
8:16.	Undetermined insect.
8:18.	Undetermined insect.
8:20.	Undetermined insect.
8:22.	Undetermined insect.
8:23.	Two May-flies.
8:24.	May-fly.
8:29.	Brown orthopterous insect.
8:30.	*Heliothis dipsaccus*.
8:35.	Undetermined.
8:38.	Caterpillar.
8:41½.	May-fly.
8:43.	May-fly.
8:45.	Brown caterpillar (cutworm?).
8:46.	*Heliothis dipsaccus*.
8:47.	Undetermined insect.
8:48.	Undetermined insect.
8:49.	Undetermined insect.
8:50.	Undetermined insect.
8:52½.	Cutworm (?).
8:55.	*Heliothis dipsaccus*.
8:56.	Undetermined insect.
8:59.	Pentatomid bug (*Nazara?*).
9:03.	Cutworm (?).
9:05.	Cutworm.
9:10.	Caterpillar (*Acronycta oblinita*).
9:13.	Brown soldier bug.
9:17.	Green caterpillar (noctuid).
9:20.	White grub.
9:25.	Clay-colored grasshopper.
9:25½.	Grasshopper.
9:30.	Undetermined insect.

A. M.	
9:37.	(Two cabbage worms placed on edge of tin can.)
9:38.	*Acronycta oblinita*.
9:39.	*Heliothis dipsaccus*. (Refused cabbage worm.)
9:39½.	May-fly.
9:45.	Grasshopper.
9:46.	Cutworm.
9:50.	Grasshopper (*Melanoplus*).
9:52.	Saw-fly larva (?).
9:54.	Miller (noctuid).
9:55.	*Heliothis dipsaccus*.
9:57.	*Heliothis dipsaccus*.
10:00.	Spider.
10:01.	*Heliothis dipsaccus*.
10:05.	Black chrysalis.
10:08.	Cutworm.
10:15.	Spider.
10:16.	Caterpillar.
10:20.	May-fly.
10:23.	Spider.
10:26.	Clay-colored grasshopper.
10:29.	Clay-colored grasshopper nymph.
10:30.	*Acronycta oblinita*.
10:35.	Green caterpillar.
10:38.	*Heliothis dipsaccus*.
10:41.	*Heliothis dipsaccus*.
10:46.	Clay-colored grasshopper.
10:48.	Spider.
10:50.	Miller (noctuid).
10:52.	Clay-colored grasshopper nymph.
10:54.	Miller (noctuid).
11:02.	May-fly.
11:02½.	May-fly.
11:15.	Green caterpillar.
11:20.	Miller (noctuid).
11:21.	Black chyrsalis.
11:22.	Saw-fly larva (?).
11:25.	Spider.
11:26.	Grasshopper (*Melanoplus*).
11:30.	*Heliothis dipsaccus*.
11:30½.	May-fly.
11:32.	Spider.
11:34.	Grasshopper (*Melanoplus*).
11:34½.	Saw-fly larva (?).
11:36.	*Acronycta oblinita*.
11:39½.	May-fly.
11:47.	Cutworm.
11:48.	May-fly.
11:50.	Cutworm.
11:51.	*Heliothis dipsaccus* (2).
11:59.	*Heliothis dipsaccus*.
P. M.	
12:02.	*Heliothis dipsaccus*.
12:06.	Spider.
12:07.	*Heliothis dipsaccus*.
12:09.	Cutworm.
12:11.	Spider.

The mother wren thus made 110 visits to her little ones in four hours and thirty-seven minutes, and fed them 111 insects and spiders. Among these were identified 1 white grub, 1 soldier bug, 3 millers (Noctuidæ), 9 spiders, 9 grasshoppers, 15 May-flies, and 34 caterpillars. On the following day similar observations were made from 9:35 A. M. till 12:40 P. M., and in the three hours and five minutes the young were fed 67 times. Spiders were identified in 4 instances, grasshoppers in 5, May-flies in 17, and caterpillars in 20. The usual difference between the food of adult birds and that of their young is less marked in the case of the house wren.

* Abridged from Yearbook U. S. Department of Agriculture for 1900.

THE MYCENÆAN QUESTION.*

The occasion for the following remarks on that difficult and much-disputed subject, the Mycenæan Question, is furnished by the appearance of the timely volume on the "Oldest Civilization of Greece," by Mr. H. R. Hall, of the British Museum, and as public interest in the whole question has been considerably quickened by the important discoveries of Mr. A. J. Evans, in Crete, this book, in which certain of the principal results of the Cretan excavations are discussed, will be heartily welcomed by the broad-minded school of classical archæologists in general, and by the student of ancient Oriental civilizations in particular.

It is now some twenty-five years since the spade of Schliemann brought to light the remains of the oldest civilization of Greece; and as it was soon recognized that these remains belonged to the period of the Bronze Age, it was clear that they must be older than the classical period of Greek culture. The excavations which were made subsequently in several parts of the Greek world by the various investigators who were

FIG. 1.—REPRESENTATION OF MYCENÆAN VASES; FROM A FRESCO IN THE TOMB OF KING RAMESES III. AT THEBES, B. C. 1200.

emulating Schliemann's example, proved that this Bronze Age culture was not confined to any particular part of Greece, but extended over the whole Hellenic area. Such discoveries compelled classical scholars to abandon many preconceived notions, and they found it necessary to revise entirely their ideas about the origins of Greek civilization; it is not to be wondered at that many excellent scholars of the "old school" still find it difficult to make their views fall into line with the new order of things in classical archæology. This is most evident when the dating of Mycenæan antiquities has to be considered, for if the Mycenæan culture, being of the Bronze Age, is necessarily pre-classical, its *floreat* must be assigned to the second millennium before Christ. An important confirmation of this view seems to be supplied by the evidence derived from the excavations which have been made in Egypt in recent years, where a large number of objects, pottery, etc., of Mycenæan origin have been found; and in many cases such objects have been discovered side by side with native Egyptian objects which must belong to the period which lies between B. C. 1500 and B. C. 1000. The discoveries of Mr. A. J. Evans, however, all seem to point to a still earlier date for the first development of Mycenæan culture out of primitive barbarism, and a useful indication of its antiquity is supplied by the discovery, recently announced, of a statue of King Khian of Egypt, in Crete. Now, the existence of King Khian was made known to us by numerous scarabs and certain monuments which were found at Tanis in the Delta and Baghdad in Turkey-in-Asia, and it is generally thought that he

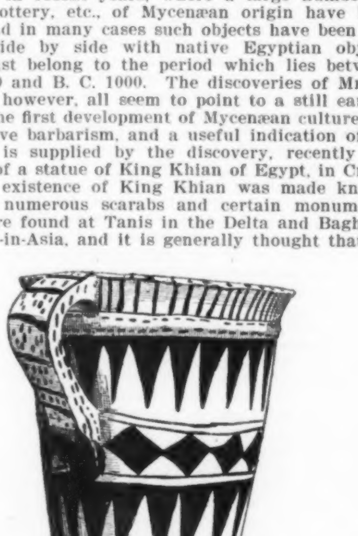


FIG. 2.—EGYPTIAN VASE IMITATING MYCENÆAN FORM, ABOUT B. C. 1350. (BRITISH MUSEUM.)

was a Hyksos king, who reigned about B. C. 1800. Prof. Petrie, judging from the style of the work on Khian's scarabs alone, has assigned this king to a far earlier date, i. e., to the period between the sixth and eleventh dynasties, about B. C. 3000; there is, however, no sufficient foundation for this view, and, so far as we know, it is not accepted by the majority of Egyptologists. The discovery of Khian's statue by Mr. A. J. Evans, in the Mycenæan Palace of Knossos, takes its place naturally in the long series of facts derived from archæological evidence collected in Egypt and Crete, which point with one accord to a date before B. C. 1500 for the beginnings of the Mycenæan period properly so-called.

The first systematic arrangement of the evidence which was derived from the discoveries of Schliemann was embodied in the work "Mykenische Vasen," by Messrs. Furtwängler and Löschcke, to whom the classification of Mycenæan pottery is due, and an anticipation of the conclusions to which Mr. A. J. Evans' discoveries appear to tend in respect of the prominent part which the Cretans took in the early Greek civilization was essayed by Dr. Milchhoefer, whose "Anfänge der Kunst in Griechenland" appeared about the same time. The position which Mycenæan archæology had reached about 1890 was well summed up in Dr. Schuchhardt's epitome of Schliemann's works, and in this book we already see the beginnings of an attempt to obtain accurate dates for the periods of the Mycenæan culture by means of conclusions drawn from results supplied by Egyptian excavations. Many

FIG. 3.—BUGELKANNE OF MYCENÆAN TYPE MADE IN EGYPT, B. C. 1350. (BRITISH MUSEUM.)

of the available data employed by Dr. Schuchhardt and his successors were supplied by the excavations of Prof. Petrie at Kahun and Gurob, and above all at Tell el-Amarna, from which site conclusive evidence of the contemporaneity of Mycenæan culture with the heretic king Amen-hetep IV. and other monarchs of his dynasty can, *pace* Mr. Cecil Torr, be deduced.

But about this time attention began to be drawn to the remains of a pre-Mycenæan period of culture in Greece, and the discoveries of Prof. Dörpfeld at Troy resulted in a definite arrangement of the prehistoric civilization of Greece in two well-defined periods, viz., the primitive or pre-Mycenæan, and the fully developed or Mycenæan Ages. The arrangement made by Dr. Dörpfeld became, in its turn, the base of a general sketch of Mycenæan archæology in the Mycenæan Age, which was published in 1897 by Prof. Tsountas and Mr. Manatt, a work which, though based on Prof. Tsountas' earlier essay, was thoroughly revised and brought up to date in the light of the most recent research. This book, however, has one cardinal defect, and the evil effects of this defect are far-reaching: Prof. Tsountas, having arrived at certain conclusions, which from the nature of the case must be of a hypothetical character, states them as so many concrete facts instead of giving the reader to understand clearly that they are only his own opinions. Since the publication of this book, however, Mycenæan archæology has entered upon a new phase, owing to the discoveries made by the British School at Athens on the site called Phylákopi, in Melos, and by Mr. A. J. Evans at Kephala, the site of the ancient Knossos in Crete, which have produced a mass of new and highly suggestive material for the archæologist to work upon; the results obtained from these excavations tend to indicate a comparatively high antiquity, i. e., about B. C. 1500, for the period when Mycenæan culture had attained its highest development. A different conclusion, however, seems to have been indicated as the result of the excavations which were carried out at Curium and Enkomi by Dr. A. S. Murray, of the British Museum, and his assistants, Mr. H. B. Walters

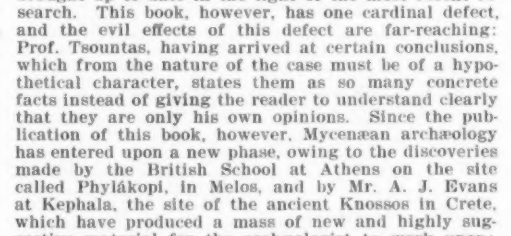


FIG. 4.—REPRESENTATION OF A MYCENÆAN METAL VASE FROM THE TOMB OF REKH-MA-RA AT THEBES, B. C. 1550.

and Mr. T. L. Myres, for the general evidence derived from the objects which they found in the course of their work shows that Cyprus continued to be included within the circle of Mycenæan culture as late as the ninth and eighth centuries before Christ. This date agrees with that assigned by Mr. A. J. Evans to the late Mycenæan treasure from Ægina which is now in the British Museum.

It has been necessary to make the above somewhat lengthy chronological statement on the Mycenæan question in order that the reader may be able to understand the exact position which Mr. H. R. Hall takes up on this disputed ground of research. He divides his work into eight chapters, which discuss the new chapter of Greek history generally, and the relation between the archæologist and historian in the elucidation of Mycenæan antiquities; the generally accepted Mycenæan hypothesis as modified by the latest discoveries; the questions of date and race; Mycenæ and the East and Mycenæ and Egypt; Mycenæ's place in history, including a discussion on the period of the introduction of the metals into Europe; and the decadence and renascence of Greek culture after the close of the Mycenæan period. The book contains in addition four appendices, seventy-six illustrations, full indices, notes, etc. Many of the facts which are given in Mr. Hall's book are familiar to us from other sources, but he has brought forward from the domain of Egyptology a considerable number which will probably be new to the majority of his readers; indeed, if we remember rightly, the Mycenæan Question has never before been handled by one whose training has made him familiar with both Greek and Egyptian archæology. His chapter, then, on the connection between Mycenæ and Egypt will be read with much interest, especially his remarks of the identifications of the northern Mycenæan tribes who attacked Egypt between B. C. 1400 and B. C. 1150. He has identified the tribe of the Uashasha with the Axians of Crete, and he has shown the probability that others of the tribes which are mentioned in Egyptian history at this period were of Cretan origin, including the Pulesatha, or Philistines.

It has been noticed that many of the names of these tribes ended in "sha" or "na," and Mr. Hall has, with apparently very good grounds, identified these terminations with the common nominal suffixes "azi" and "ñna," which are found in the Lycian language and, seemingly, also in other cognate speeches of Asia Minor. Mr. Hall seems also to have devoted his energies to the solution of the difficult problem of dating the early antiquities of Greece, and, so far as we understand him, he takes in this respect a position midway between those who hold that the latest date possible in Mycenæan archæology is B. C. 1100 and those who hold, with Dr. A. S. Murray, that this date is more likely to be the *earliest* which can be assigned to Mycenæan antiquities, i. e., he believes that in Greece proper and in Crete the Mycenæan culture began at a very early period—which, however, he does not define exactly—and had already reached its highest pitch of development about B. C. 1500, when its chief seat was in Crete, and when it was extending its influence to Egypt and Asia Minor. He considers that the discrepancy between the two extreme views can be reconciled on the theory that in Greece proper the Mycenæan age came to an end about B. C. 1000, but continued to exist in Asia Minor until about B. C. 800, and in Cyprus until a century later.

This view is, perhaps, confirmed by the fact that the Dorians, who, *ex hypothesi*, overthrew the Mycenæan culture in Greece, did not reach Asia until about B. C. 800, and never gained any foothold whatever in Cyprus. Another important point made by Mr. Hall is that, contrary to the usually accepted view, iron was already known to the Egyptians about B. C. 3500, when, as he says (see p. 198), "it appears named and depicted on the monuments in a manner which admits of no possibility of doubt as to its nature." He supports his statements by quotations from a learned article by the Swedish Egyptologist, Prof. Piehl, which appeared in Ymer (1888, p. 94 ff.), from which it may be safely concluded that the Egyptians were acquainted with the use of iron some 2,500 years before it came into general use in Europe. We notice that the passages which Mr. Hall quotes from Egyptian texts are translated by him especially for the purposes of this book, and he weighs with discretion the evidence which many would derive from the cuneiform and from the so-called "Hittite" inscriptions for the elucidation of the origins of Mycenæan culture. It is interesting to note that he believes it possible that the system of writing which was in use among the Cretans may have been derived from the Egyptian hieratic, and he points out some probable instances of the similarity between the two scripts; but, contrary to the opinion expressed by Mr. A. J. Evans, he thinks that the writing is to be read from right to left, because the figures of men, birds, etc., which occur in it invariably face to the right, and should, on the analogy of Egyptian, face the beginning of the line. Still, it must not be forgotten that, chiefly owing to geographical difficulties, there cannot have been much direct communication between Crete and Egypt across the open sea in the Mycenæan period, and the connection between the two countries must have been carried out via Cyprus and the coast of Palestine; and it is a fact that the Cretan and other

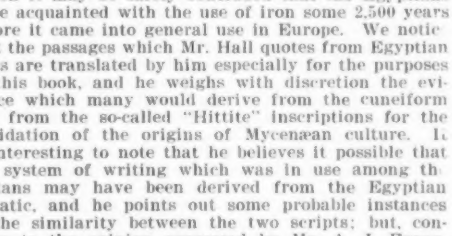


FIG. 5.—REPRESENTATION OF A MYCENÆAN METAL VASE FROM THE TOMB OF REKH-MA-RA AT THEBES, B. C. 1550.

northern marauders who attacked Egypt in the reigns of Menephthah and Rameses III. made their way to Egypt by this route.

There are many other points of interest in the book to which we should like to draw attention, but our space is exhausted. The Mycenæan question is a difficult one, and one which, in our opinion, will not be settled for some years to come; the evidence which will bring about this result is accumulating, but there is not enough of it available yet. The most serious phase of the question as it now presents itself is the discrepancy between the dates assigned by experts for the beginning and end of the period of Mycenæan culture proper. Mr. Hall does not claim, if we understand him aright, to have settled this difficulty, but there is no doubt that he has collected a number of facts which will one day form valuable elements in the solution of the problem, and he has set forth the Egyptian aspect of the Mycenæan question in a clearer form than any of his predecessors. His volume contains an excellent summary of the work already done, and will give the reader a capital idea of the position of the workers in the Mycenæan field; it will also

* The Oldest Civilization of Greece: Studies of the Mycenæan Age. By H. R. Hall, M.A., Assistant in the Department of Egyptian and Assyrian Antiquities, British Museum. Pp. xxxiv + 346; with 76 illustrations. (London: D. Nutt, 1901.)

enable him to take an intelligent interest in the labors of future workers and to appreciate the developments of a most fascinating line of research.

POLYLITHIC SCULPTURE.

THE prophecies of Baruch are among the Apocryphal books. Baruch, whose name probably conveyed the same meaning as Benedictus, was the faithful scribe of the great prophet Jeremiah and his fellow-sufferer. It is believed he was present at the siege of Jerusalem under the lieutenant of Nebuchadnezzar, and was one of the exiles in Babylon; he therefore lived six centuries before Christ. Baruch, like the majority of the religious Hebrews of his age, was afraid of art, and especially of sculpture. He considered it to be his mission to raise his voice against the statues of wood, gold and silver which were to be seen in the East, and which he thought were employed as idols. He reproaches the other nations with their weakness and blindness, and with that remarkable power of sarcasm which was a characteristic of the prophets, he mocked the people for the pains which they took in adorning such figures. He declared that serpents used to eat the hearts of their gods, that they were without feet, and had to be carried. In this view we can trace the influence of Jeremiah, and, indeed, the epistle bears the name of the greater prophet.

The statement is of extreme importance in the history of art, although Baruch's book may not be accepted by some classes of theologians. It is certainly early evidence, and from its peculiarly Hebraic language it cannot be the composition of a later age. From what the prophet says about the devouring serpents, it is to be assumed that the body of the statue was carved out of wood, and that the gold and silver were either used for parts of the figure, such as the face and the hands, or for its adornment. It is easy to understand that Semitic tribes would think more of the material employed in a statue than of its qualities as a work of art. To meet that weakness the artists may have covered the parts which were visible with precious metals. It is noteworthy that whenever the prophet speaks of an idol he always describes it as if it were a combination of gold, silver and wood. The idols which Baruch detested were not unique. Among the Greek sculptors of a later time the use of gold and silver with wood was common, and in that way may have originated the golden masks which were employed as late as the Gothic period.

The meaning of the allusion to the absence of feet cannot be explained with certainty. Some of the idols may not have been "selbstständig," to use a Germanism, and were used solely in processions when they were carried by priests. Figures of the kind were not uncommon in ancient days, but the prophet may also have endeavored to bring home to the votaries how helpless was the thing they honored. What is remarkable in Baruch's diatribes is that he also speaks of drapery as an adjunct of the idols. We know from the Assyrian figures how much importance was attached to beautiful robes by the Asiatic kings and courtiers. We may even conclude the rank of people was expressed by their dress. From various allusions it has been assumed that at a later date draped sculpture was familiar in Greece, and it has been affirmed that a statue of Venus which was found at Pompeii must have required for its completion the aid of drapery which could be changed from time to time. From Baruch's master, Jeremiah, we also learn much in a few lines about the character of the idols. We are informed how they were cut out of a tree of the forest, they were decked with silver and with gold, they were fastened with nails, they must needs be borne because they could not go. Then it is said, "Silver spread into plates is brought from Tarshish and gold from Uphaz, the work of the workmen and of the hands of the founder; blue and purple is their clothing; they are all the work of cunning men." It is not stated that blue and purple textiles were used, but we may conclude from the words of the two prophets that was the practice in the East 2,500 years ago.

The best Greek works are undoubtedly in white marble, but John Gibson was not the only expert who believed that the figures were colored or delicately tinted. There was a love of color among the Greeks as among the Easterns, and they were prepared to make sacrifices in order to gratify their eyes. Besides, the mythology of the Greeks was represented by a great number of figures, and although the artists may have adhered to certain types to make apparent what deity was before a spectator, the use of ornaments as auxiliaries for that purpose was, therefore, recognized as legitimate. Gold and silver were best adapted to express whatever was symbolic.

There is accordingly sufficient evidence that besides the chryselephantine statues and the tinted statues, there was an older class made up of several materials. It was likely to occur to such keen logicians as the Greeks that robes which were not enduring were not adapted for statues, which would depend for much of their interest on their age. For the same reason gold and silver, which were temptations to thieves, were undesirable. Whatever the cause, we know that statues made up of more than one kind of marble were prepared. Greece was rich in marbles, and it was possible to obtain materials that would be suggestive of others of a different class. Not only gold and silver, but draperies could therefore be imitated with sufficient accuracy and without much expenditure of money. A yellow marble was to be found in Corinth, Melos and Macedonia which served for gold; there was a black marble in Miletus which recalled ebony; the purple robes could be represented by Lydian marble, and so on. With men of taste, the figures of colored marbles were not acceptable, but the vulgar rich patronized them, and on that account it appears they were mentioned by Menander as one of the accompaniments of luxury. The multi-colored arrangement was not confined to marbles. Bronze heads, feet and hands were employed with marble figures, and sometimes there was a reverse practice, and to figures in bronze extremities in marble were added. Vitruvius, in his second book, calls such statues *akrolithoi*. It is possible that when occasion demanded, heads were changed, and a man who wished to be agreeable to his guests would require to be possessed of a stock of portraits of their favorites. Some toy-books for children, which were in use in the early part of the last century, included a number of heads that could be added to one body, and were possibly a survival of the Greco-Roman sculptor's practice.

Sometimes the employment of different materials was more delicately carried out. According to Pausanias, there were bronze statues in the city of Clœtas in which the nails only were of silver. There was more naturalness, perhaps, in using an exquisite marble or precious stones to express the eyes, which was a common practice. It would appear that in the Roman studios there were specialists who were called in for that class of work, and instead of being described as a sculptor, the man became a *faber ocularius*.

Neither Baruch nor Jeremiah mentions the existence of marble idols, unless they are comprised under the generic term stone. It is possible they were not present at that time in many parts of the East. According to Pliny, the use of marble was known to Greek sculptors about the year 580 B. C. Baruch was probably then living, but it was not likely that he took any concern in the progress of art in Greece. No doubt the early figures of stone or marble were stiff in their attitudes, but much of that quality would be lost if drapery were introduced.

It cannot be said that the use of colored marbles in sculpture has ever died out. Composite figures were pleasing to Roman amateurs. From time to time examples are met with which show that the arrangement continued to find favor as time went on. During the later Renaissance many examples were produced, and they were more in keeping with the unrestrained luxury in furniture and decoration to be found in the interior of palaces. Occasionally instances are still to be seen in auction rooms, and there is probably not one of the principal London dealers in bric-à-brac who would not be able to produce large busts or terminal figures which are formed of different colored marbles with or without bronze. The class of art may be condemned, but it has antiquity in its favor, and it is not without alliance with various other classes of art. It provokes also a comparison with painting, and as an element in decoration it might occasionally be turned to account.

Marble pictures, which differ from mosaic by the avoidance of any particular form of tesseræ, were also in favor as a wall decoration. In a church at Antwerp, of which Rubens was to some extent the architect and superintendent of decoration, they were tolerated by him, although with his own hand he could fill the spaces occupied by them in a fraction of the time devoted to cutting out the fragments from marble. But the great Fleming could be generous, and wished to give a helping hand to artists in other materials besides paints and canvas.—The Architect and Contract Reporter.

MEN AND MICROBES.

By E. STENHOUSE, A.R.C.S., B.Sc.

THE end of one century and the beginning of a new one seems an appropriate time for a stock-taking of progress—a time when we may usefully pause to estimate, to the best of our ability, the position in nature to which "civilization" has brought us.

In such a mental survey at the present time nothing is more striking than our recognition of the fact that our daily lives are intimately bound up, for weal or woe, with the activities of countless hordes of tiny beings whose very existence was undreamt of a hundred years ago.

Bacteria or microbes are as ubiquitous as anything well can be. They occur in the water we drink, in the air we breathe, in the soil beneath our feet, and even in the interior of our own bodies. Were it not for the many services they continually perform for us, our life would be quite impossible; and, on the other hand, they have been proved to be responsible for the greater number of the infective diseases to which we are subject.

So minute are the possessors of these boundless powers of good and evil, that it is often necessary to magnify them some 800,000 times before they can be seen at all distinctly. To give some idea of this enormous magnification, it may mentioned that an ordinary cigarette magnified in the same proportion would appear seventy yards long and about twenty-eight feet thick.

A bacterium of the cigarette shape is known as a *bacillus*. The place of the tobacco of the cigarette is taken by a jelly-like substance called protoplasm; and the cigarette paper is represented by an envelope which, however, covers in the protoplasm completely—at the ends as well as at the sides of the bacillus. Many bacilli possess threadlike growths, by the lashing of which they are propelled through any liquid in which they may find themselves. Other forms, called *spirilla*, move by a serpentine twisting of their slender bodies; and yet other bacteria are globular in shape and are known as *cocci*. When a bacterium is full grown, it multiplies by breaking up into two or more pieces, each of which becomes a complete bacterium. As a bacillus becomes adult in half an hour, or less, one individual can thus give rise to about 17,000,000 in twenty-four hours. When the supply of food runs short, or the surroundings become in other respects unfavorable, many bacteria form themselves into spores, which possess very great powers of resistance. They remain in the resting stage until the hard times are over, and then, with unimpaired vigor, resume their ordinary mode of life.

Of the many useful services which bacteria perform, perhaps the most conspicuous is that of breaking up refuse animal and vegetable matter into harmless and often useful substances. That the putrefaction of organic matter is really due to minute and airborne forms of life was proved conclusively by Pasteur and Tyndall about the middle of the nineteenth century. It was shown that if well-boiled broth is kept in vessels from which the air is either wholly excluded or so admitted that all floating particles are arrested, no putrefaction occurs, and the broth remains sweet for an indefinite time.

The importance of bacteriological research is persistently forcing itself upon the attention of municipal authorities, not only because it shows how disease-epidemics may be best prevented and stamped out, but also because it indicates solutions of such important problems of public health as the disposal of sewage. Various modifications of the biological treatment of sewage are already at work in this country, and are giving very encouraging results. Essentially the process consists in passing the sewage—which may previously have been partially purified by allowing the grosser particles to settle in the tanks—through filter beds of clinker or broken coke. A scum soon forms on the coke, and microscopic examination shows that the scum swarms with myriads of bacteria. The bacteria break up the foul organic matter into harmless substances. The efficacy of their work may be judged by the fact that, of several effluents I have recently analyzed, the putrescent organic matter had on the average been reduced to less than one-seventh as the liquid was trickling through the coke.

It has been found that bacteria play a most important part in enriching the soil with nitrates, a very necessary food of plants. Generally the raw material consists of the simpler compounds of nitrogen—those of ammonia, for example; but the roots of leguminous plants contain bacteria with the very remarkable power of taking nitrogen directly from the air and putting it at the disposal of the plant.

The propriety of including yeast-cells with bacteria is, perhaps, questionable; but the indirect influence upon frail humanity of these minute manufacturers of alcohol is so great that they can scarcely be ignored here. It is becoming widely recognized that several species of yeasts exist, and that success in brewing depends largely upon the rigorous exclusion of the "wild" varieties.

The careful work of the brewer may be brought to naught in a few hours by the activities of another microbe, should it gain access to the finished beverage. The vinegar organism, as it is called, attacks the alcohol and changes it into acetic acid. Neither beer nor wine ever "goes sour" of itself, if this little plant is absent. Similarly, milk is turned sour by the lactic acid bacillus. Still others give their characteristic flavors to butter and cheese; and it has even been asserted that many of the changes which tobacco undergoes in curing and mellowing are due to the action of bacteria. Certain workers are at present investigating this important point, with the object of breeding pure cultures of the races to which a good cigar may owe its peculiarly seductive aroma.

These are a few only of the almost numberless cases in which we are indebted not only for our luxuries but for the very means of life itself, to the silent but ceaseless labors of these tiny organisms. Moreover, if there is anything whatever in the theory of modification by descent, we ought to be able—considering their fabulous rate of multiplication—to bring about in a comparatively short time changes in the structure and habits of some of our "tame" bacteria which will make them minister to our health and comfort to a degree hitherto undreamt of.

While, however, we freely admit our great indebtedness to bacteria, we must not forget that their powers for evil are also enormous.

In 1849, Pollender discovered minute rod-like bodies, one four-thousandth of an inch long, in the blood of animals which had died of anthrax or splenic fever, and he suggested that these tiny rods bore some definite relation to the disease. Fourteen years later Davaine announced that the rods were living plants, and that blood containing them had the power of passing on the disease to another animal inoculated with it; while blood from which the bacilli were absent had no power of conferring the disease. About 1876 Koch discovered how to grow the organism outside the body; and Pasteur subsequently found that by keeping artificial cultures of the anthrax at a temperature slightly above that of the blood the organisms gradually lost their deadly power, and after 43 days had no injurious effects upon even the most susceptible animals. After being inoculated with such harmless cultures, the animals were subjected to the action of cultures of gradually increasing strength, until after a short time it was found that they could easily withstand a dose which would at first have proved immediately fatal. The animals had, in fact, become protected against the disease. This brilliant discovery has already been put to very extensive use, and the method of inoculation is now recognized as a certain means of protecting horses, sheep, cattle, and even elephants against the ravages of splenic fever.

The activities of the anthrax bacillus may be regarded as illustrating the ways of malignant bacteria generally. There is, however, considerable variation in minor details of structure and mode of life. For example, while the rod-shape or bacillus is the form of the organisms responsible for anthrax, typhoid, diphtheria, "consumption," and some other diseases, the microbes giving rise to erysipelas are not bacilli, but minute globular bodies (cocci) which stick together in rows, like beads; and the cause of cholera is a tiny comma-shaped bacterium. While, again, some microbes gain access to the blood, and thus by their marvelous powers of multiplication spread throughout the whole body, others remain at the point of inoculation, and yet set up profound disturbances in the system generally which ultimately end in death.

The last-mentioned fact, that the organisms themselves may be restricted to one point, while their evil effects may extend throughout the body, suggests that during their life they give off poisonous substances to which, rather than to the bacteria themselves, the diseases are due. This has repeatedly been proved to be the case. Here, again, anthrax furnishes an instructive example. It has been found possible to prepare from artificial cultures of the anthrax bacillus an intensely poisonous substance, which is nevertheless free from the bacteria; and this poison or "toxin" of anthrax induces, if injected into the blood of an animal, all the characteristic symptoms of the disease. Nor is this all. The strength of the toxin can be so regulated that while it is insufficient to cause death, it protects the animal against future attacks.

The theory which at present best explains these remarkable facts is that the toxins stimulate certain cells of the body to manufacture substances which neutralize them. These toxin-destroying substances

are called "antitoxins." Once the cells have got into the habit, so to speak, of producing antitoxins, they continue the work, and lay in a stock which is sufficient to promptly render useless the poison armory of the particular race of bacteria, should these again invade the territory.

The fact that the terrible zymotic diseases are due to blood-poisoning by toxins, and the possibility that for every toxin there is a corresponding antitoxin—in other words, that every disease produces its own antidote—which may yet be discovered and isolated, are sufficient to explain the tireless enthusiasm with which bacteriologists have of late years carried on their researches. Marked success has in many cases attended their efforts, and the manufacture of certain antitoxins is now carried on upon a somewhat large scale. The antitoxin of diphtheria, for example, is regularly prepared by a large German firm, and sent out to all parts of the world. The bacilli of the disease are first grown in specially prepared broth for about a month, by which time the fluid has become strongly impregnated with the poisonous toxin. The bacteria are filtered off, the clear solution obtained containing the toxin. This is then injected into horses in gradually increasing doses, until the animals can withstand a large quantity without inconvenience. Then after a few days rest they are bled from the jugular vein. The whole operation is so carried out that the horses suffer practically no pain whatever, and very little injury to their general health. The blood is allowed to clot, and the clear fluid (serum) which rises to the top contains the antitoxin, and is hence known as anti-diphtheritic serum. It is now injected, in doses varying with the severity of the disease, into patients suffering from diphtheria. As a result of the treatment the mortality from this disease has been greatly lessened. Antitoxins have also been prepared for protection against and treatment of various other diseases, including typhoid, tetanus (lockjaw), plague, hydrophobia, and snake poisoning. A few years ago there seemed to be grounds for believing that a cure for consumption had been discovered. The anticipations were, unfortunately, not realized; but the extract of "tuberculin," which it was hoped would rid humanity of its greatest scourge, forms a means of identifying tuberculous cows, and thus of removing one source of the disease.

The indictment against these low forms of life is a terrible one. Disease and dirt are, however, closely connected, and the introduction of better sanitary conditions will of necessity exterminate many diseases. As a rule, only those in a low state of health need fear these minute foes, for they are in nearly every case unsuccessful against vigorous constitutions. The various fluids of the healthy body have a distinctly injurious effect upon malignant bacteria, and it has recently been found that there are in our bodies certain wandering cells which in health act as policemen, promptly seizing and devouring the harmful microbes which do gain access to the system. The tonsils, for example, are crowded with these guardian cells.

The fact that during the progress of a disease the blood acquires properties inimical to the growth of the bacteria is very marked in the case of typhoid, and affords a means of diagnosing the disease. If we examine microscopically a drop of broth containing a young culture of the typhoid bacillus, we see the deadly plants darting and wriggling about the field in all directions. On diluting the drop with healthy blood-serum, no loss of activity is to be seen, but if the added serum is that of a patient suffering from typhoid, the movements slow down, and the bacilli seem as if paralyzed. They collect in separate clumps, strongly suggesting different swarms of midges, and in a minute or two all is over. The bacteria are dead. The sight is, in its way, as striking as anything I have seen. It irresistibly brings up before the imagination the fierce struggle which goes on when disease germs invade the body. Should they escape arrest by the "policeman-cells," they begin their deadly work, but all the reserve forces of the invaded country are called out. The intruders have first to fight against the healthy fluids of the body. If these are unsuccessful the bacteria live and multiply and give off their poisons. Immediately, however, the body responds and brings forward a supply of antitoxins. Then it is war to the knife. If the bacteria can produce toxins faster than the body can supply antitoxins, they win, and the patient sinks. The only hope is that, before general collapse has gone too far, a timely injection of the required antitoxin may put the enemy to rout.

The possibility of the last resource is due to the labors of such men as Pasteur, Lister, Koch, and their followers. They have shown that we have to fight for our lives against enemies, unimaginably small, but present everywhere and in countless myriads; but they have also been able to classify the foes into races and nations, to discover their various methods of attack, and in many cases to forge weapons by which these attacks may be foiled. The work is only in its infancy, but there is every reason to believe that its ultimate achievements will do more for the well-being of mankind than any other nineteenth-century discovery.—Knowledge.

THE EMPIRE OF THE AIR.

SINCE the times of prehistoric Hellenic legend, the impulse to attempt the navigation of the air has always been latent in human nature. It crops up throughout the Middle Ages, and few readers of Carlyle forget his description of the prisoner, Sergeant Drouet, attempting to escape from his prison on the Danube by the assistance of a crude flying machine. We have attempted to chronicle, from time to time, the modern attempts toward a solution of the problem which have been recently made on the Continent, and we have occasionally dealt with the subject to a certain extent, from the scientific point of view. The past month has witnessed what is by far the most successful of all attempts in this direction. As our readers are aware, M. Santos-Dumont's navigable balloon, though it has not in the various attempts, owing to mishaps, actually succeeded in winning the Deutsch prize, has only just failed to do so. It has maneuvered against the wind, encircled the Eiffel Tower, and generally behaved in a manner which, but a few years ago, would have been looked upon as an impossibility. So many have been the triumphs which the study of nature and the application of natural laws have enabled man to achieve in the last few decades, in the control of elemental forces, that occurrences which at an earlier date would have given rise to universal excitement and enthusiasm, at the present day take place without producing more than the slightest ripple on the surface of society. Nevertheless, few readers of the accounts which appeared in the morning papers of M. Santos-Dumont's first really successful trip can have failed to experience the sensation that they were privileged to be the contemporaries of an epoch-making occurrence.

The regrettable accident which occurred when M. Santos-Dumont was making his last trial for the Deutsch prize—when he had rounded the Eiffel Tower, and when he was on his way back at apparently high speed—has little bearing on the general consideration of the subject. Accounts differ as to what was its real cause. Most seem to attribute it to the stopping of the fan which pumps air into the balloonette, which is arranged inside the main balloon to compensate by its expansion for any loss of hydrogen which may take place. If this were so it would suggest that the tube in question had not been provided with a non-return valve. We hesitate to assume without more direct evidence that M. Dumont would have omitted such an obvious precaution. Whatever the real cause, however, there seems little doubt from the number of successful experiments already made that the accident was due to some failure of detail and is in no wise inherent in the system adopted.

What the ultimate future of aerial navigation may be no one, not even Mr. H. G. Wells, can really attempt, even approximately, to foretell, but the step in advance which has been made by M. Santos-Dumont has undoubtedly the air of having left all previous attempts in the same direction distinctly in the rear. We publish elsewhere an illustrated description of the Santos-Dumont airship, which comprises, we believe, all the available technical information on the subject, which we would point out, might with advantage, had M. Santos-Dumont been more communicative, have been considerably more ample. Such as it is, however, it enables the main lines on which he has attempted to solve the eternal problem fairly comprehensible, and we would refer those of our readers—and we venture to think they are among the greater number—who are interested in the solution to the account in question. For the present we propose to consider in a general way the conditions of aerial navigation, to occupy ourselves, that is to say, in what is necessarily in the limits at our disposal, with a somewhat superficial review of the facts which ultimately tend to determine which of the two types of machine—the airship or navigable balloon, or the flying machine proper—is most likely to have a future before it.

We do not propose to deal with the question too deductively; above all, we desire to avoid the mathematical method of attacking the problem. Such attempts in the hands even of experts have in the past given rise to very curious results—among others to the conclusion that an airship of the Santos-Dumont type would require upward of 100 horse power to propel it at 15 miles an hour. As a 16-horse power motor not developing its full capacity has proved capable of driving the airship at a greater speed than this, there is obviously something wrong with this method of treatment. One is reminded to a certain extent of Galileo's *"e pur si muove,"* the airship moved in spite of the mathematicians. This, however, need not surprise. When we come to consider how extremely complex is the mathematical treatment of the dynamics of even a single particle, one can easily see that mathematical deductions, even where the data on which they are based are unexceptionable, on such an extremely complex subject as the movements of a solid body in a gaseous medium, are highly liable to be fallacious. We desire, therefore, to consider the matter from a less recondite point of view, and to consider it if possible to placing the general reader in a position to form an opinion for himself as to the rival merits of the two principles.

Attempts to solve the problem of aerial navigation have hitherto been embodied in two great classes of machines, the navigable balloon and the aeroplane. The latter is mainly associated in the popular mind with the extensive experiments of Mr. Hiram Maxim. These experiments prove that an aeroplane as constructed by him with sufficient power to drive it would raise itself off the ground and would go along running on an overhead rail. This machine was of sufficient size to carry several passengers, but it never appears to have made an actually independent flight carrying anyone with it. Independent short flights have been made by machines more or less on the same principle, but not carrying a passenger. The arrangement is generally so risky that presumably no passenger has ever had the necessary courage to intrust himself to its uncontrolled mercies.

The aeroplane, as our readers are doubtless aware, is a machine the leading feature of which is a plane surface either of stretched canvas or light metal, which is intended to act like the outstretched wing of a bird on the "skim." The motive power is furnished by a propeller, more or less similar to that employed by M. Santos-Dumont. The aeroplane may, therefore, be looked upon as a gigantic bird, divided mechanically into two, the propulsive effort being furnished by one portion of the mechanism, and the sustaining element such as it is by another. It might be compared to a bird with outstretched pinions propelling itself by vigorous agitation of its tail. Now there are many things that lead us to the conclusion, though as the humorist said, "Of all the mistakes that we can commit, that of prophecy is the most gratuitous," that there are limits to the size of the structure on which the bird principle can practically be carried out. It is a curious fact in nature that birds, that is to say, birds which fly, are limited in size. When we go back to the palæontological records of fossil birds and winged reptiles, we do not find any appreciably bigger than the albatross and the condor, the largest flying birds of the present day. In other departments the geological records furnish us with immensely larger types of other animals. The reptiles and mammals of the present day are small compared with the biggest products of former days, but with flying animals the case is different. This suggests at any rate that we find no larger flying animals as fossils (not even the archæapteryx or the pterodactyl) than the albatross and condor, because these latter have reached the limits. There is a certain ratio between mass and superficial area which comes into play whenever a solid body falls through the air. If its weight relatively to its surface is great, then what is known as its terminal velocity when falling through air is enormously high. For instance, a lump of granite of a cubic inch in size would have to be dropped from a point very high up, indeed, in the atmosphere for it to attain its terminal velocity before striking the ground. If the same lump of granite were smashed up into powder the particles of the powder would attain their terminal velocity very quickly. By a terminal velocity is meant that velocity at which the resistance of the atmosphere becomes so great as to counterbalance and prevent any increase of velocity due to the acceleration of gravitation. That velocity, therefore, is terminal. It will not increase any further.

It is for this reason that the velocity with which rain strikes the earth is entirely independent of the height from which it falls, but depends only as a rule on the size of the drops. Now a similar play of forces comes into action in the case of a bird, which has to depend for its ability to stay up upon presenting an enormous surface to the resistance of the atmosphere, compared to its weight, and the heavier you make the bird the greater does this surface have to become; that is to say, the greater the stretch of its wings. But not in direct proportion—far from it. It is something, we believe, like the square, or some higher power of the weight. The bigger wings become, however, the more energy is required to move them, and, in spite of the fact that birds with their hollow bones are much the lightest of all animals, a point is soon reached at which, however powerful the bird may be, it will be impossible for it to exercise sufficient energy to flap its wings. It is probable, too, that the direct action of the wings in propulsion is more efficient than employing, as in the aeroplane, the wings merely to sustain, and using a separate arrangement to propel. Further, we must remember that the animal is the most efficient of all machines. These appear to be among some of the reasons why it may ultimately turn out that an aeroplane of sufficient size to be practical may, after all, be an impossibility.

There are the other questions of manipulation and control which are obviously much more complicated where the difference between maintaining a steady flight and making a precipitate somersault to destruction, may depend on differences in the angle of the inclination of the aeroplane of perhaps only a few minutes. That, however, is perhaps the least important consideration, but it seems impossible to set any bounds to the capabilities of man in learning the control of mechanism. When we consider the airship or navigable balloon we deal with an altogether different set of problems. The airship of the Santos-Dumont type—a type in which we may include the earlier attempt of Count Zeppelin—bears the same relation to the air that a submarine boat does to the water.

If the latter is capable of successful construction and management, it would appear that the former ought to be so likewise. It is only a matter of difference of degree, of larger bulks to replace larger quantities of the lighter fluid, and thereby obtain the necessary buoyance. The resistance to movement owing to direct impedence and to skin or tangential friction of the fluid in which either machine is being maneuvered, probably conforms to similar laws. We say similar, because we do not know whether the increase of tangential friction with velocity goes up in a gas in the same ratio as in a liquid. There seems to be reason to think that it does not, and if this be so it is a point in favor of the airship.

On the other hand, there is a point which makes in favor of the aeroplane, or at any rate against the airship, as we at present know it; that is, the extreme difficulty of confining hydrogen gas inside a balloon, or for that matter inside anything else. Envelopes that are practically impervious to ordinary gases let hydrogen through them at an alarming rate. At present this fact tends to limit the time for which apparatus depending even partially for their support on a volume of hydrogen can be maintained in the air.

In the Santos-Dumont airship the balloon portion of the structure is designed to just overcome the dead weight of the motor, propeller, shafting, and framework. The vessel is not intended to rise as a balloon. Rising is effected by altering its balance in such a way as to cause it to point upward, the propeller having the effect of causing the machine to travel in any direction in which its nose points. Descending is similarly effected by depressing the nose (or ought we to call it bow?) of the machine. In these respects it will be seen that it completely corresponds to a submersible submarine. The advantages of this principle are fairly obvious. One is not being kept up by the machinery. If the engine breaks down, the airship will slowly and gradually sink to the earth. There is no necessity for rigidly keeping aeroplanes at exactly the right angle under penalty of disaster, and at the same time, as the balloon is only a float and has not to do the actual lifting, its dimensions can be reduced to the smallest possible limit, thereby restricting the resistance of the air. So far the results obtained are highly encouraging. The future of such arrangement seems to depend mainly on the question how far the capacity of motors can be increased relatively to their weight on the one hand, and how far the necessarily increased size of the balloon that will be required for larger structures on the same lines will neutralize the advantages obtained thereby. There seems, at any rate, to be a decided promise of tangible results, provided that in the near future experimenters are content with moderate speeds, and refrain from too venturesome attempts to ride the whirlwind and defy the storm.—The Automotor Journal.

ST. ULRICH AND THE INDUSTRIES OF GRÖDNERTHAL.

By EMIL TERSCHAK.

FOR the tourist who comes by rail from the north or south, the station of Wiadbrück, on the Eisack, is the entrance to Grödnerthal. From Wiadbrück a good road leads eastwardly through the narrow valley up to the brewery of St. Peter. Here for the first time a brief sight is caught of the huge Langkofel Mountain. Proud and majestic this wonderful rock towers over the woody hills and green precipices. Beyond St. Peter's the road rises again; then the valley broadens, and we see the friendly little town of St. Ulrich, which with its 1,640 inhabitants constitutes the metropolis of Grödnerthal. Many a traveler who has pictured St. Ulrich to himself as a homely village is astonished when he finds a small town whose neat, clean houses impress him with the comparative wealth of the people. After a longer stay in the valley the stranger will soon find that Grödnerthal and its trade play no small part at least in commerce. But Grödnerthal is remarkable not only for its local development. It has already a foreign commerce which is increasing year by year, despite the protests of the more narrow-minded portion of the community. Without laying claim to any prophetic vision, one can easily foresee what the future of this valley will be. To be sure, trade with the outer world is of but recent origin. Not until 1870 was this beautiful region opened to the vast army of tourists that overruns Europe each year. Slowly, but constantly, the number of visitors to the valley has increased; and in the last years the number of tourists has been so far augmented that during the height of the season none of the inns or private houses was able to accommodate a single additional person. Cheap lodgings and the beautiful scenery are the causes of this increasing interest in the valley.

The people of Grödnerthal are a branch of the Ladins, and have from time immemorial inhabited the valleys of Gröden, Ennerberg, Buchenstein, Fassa, and Ampezzo. To this very day the language and customs in Grödnerthal have come down to us with little or no change.

The inhabitants of Grödnerthal are modest, industrious folk. By their own enterprise they have brought their industry to a profitable stage of development. The articles which are carved in Grödnerthal are chiefly toys (such as dolls, horses and other animals, doll-heads, wagons and the like), religious figures and profane articles. Most of the carvings are colored. In the seventeenth century Grödnerthal also made laces; but now lace-making is not practised. Men and women, young and old, now subsist from the carvings which they make and sell. One of the specialties of the Grödnerthal woodcarver is the wonderfully-executed figures of Christ. There are in Grödnerthal sculptors who may be said to possess even genius—artists born to hold a chisel, men who are completely absorbed in their work. The effect of the spirituality of the middle ages has not altogether been lost even in our own day. Besides the various studios and workshops which dot the valley, the two churches are of considerable interest. St. Ulrich's church was built between 1793 and 1795, and is, therefore, constructed in the so-called neo-Italian style. The paintings were executed by Franz and Joseph Kirschebner, of Innsbrück; the high altar picture by Joseph Moroder, born in Grödnerthal. The church of St. Anthony was erected in 1666. Its statues of Sts. Rupert and Ulrich were executed by the sculptor Dominik Vinatzer (1682); the altar picture by P. Deschwanden. The collection of ornaments found at Coldeflam is also well worth seeing.

In dress, at least, it must be owned that the people of Grödnerthal have somewhat departed from the manners of their ancestors. The men dress in the most approved modern fashion, but the women still cling to the old costume. Of the change which has taken place in dress during the course of many years; of the customs which have been handed down from father to son; of the language and the many details of the industry of the valley, much may be read in Franz Moroder's book, "Das Grödner Thal." The wealthy women of Grödnerthal are proud of their family jewels. On important holidays they sparkle with rings, chains, and crosses, big and little.

The language is not a written language. In Grödnerthal the Ladin language has been preserved with more purity than elsewhere. Nevertheless almost every man and woman speaks German. Franz Moroder remarks in his book: "Similar to the Italian language in sound, the speech of the people of Grödnerthal is nevertheless decidedly different; and although it is related to the Romance tongues of Ennerberg, Fassa, Buchenstein, and Grödbendenn, it is nevertheless distinguished by the difference of pronunciation, and also in its idioms."

In wintertime when the hills are covered with snow the wood is hauled to the valley by horses. I have often seen how the mighty trunks of buttonwood or pines have been hauled down steep pathways. The trunk is chained at its front end to a small, but very heavy sled; the remaining portion of the trunk is allowed to drag along without any support. So great is the demand for buttonwood that many of the trees are purchased elsewhere.—Ueber Land und Meer.

A WORKSHOP IN GRÖDEN.

THE BEET SUGAR INDUSTRY.

THE growing belief that the United States will shortly be able to produce from beets the $100,000,000 worth of sugar which her people now annually import seems to be shared by British Consul Wyndham, who has given the subject close attention and reported upon it to his government. The following is an extract from his report which has just reached the Treasury Bureau of Statistics:

"The production of beet sugar in the United States is rapidly increasing, and in the Chicago Consular District there are four factories in the State of Illinois, three in Nebraska, and three in Colorado. Those in Nebraska and Colorado belong to the American Beet Sugar Company, and are at Grand Junction, Rocky Ford, and Sugar City, and when fully completed will employ thousands of hands.

"Statistics indicate that the United States consumes more sugar than any other nation, or approximately one-quarter of the whole of the world's product. The conditions of soil, climate, and other advantages are quite as good in the United States, and especially in Colorado, Nebraska, and Illinois, for the development of the beet as in any of the countries of Europe or Asia. The world's production and consumption of sugar is now about 8,250,000 tons per annum, two-thirds of which is produced from beet and only one-third from cane, while the normal consumption is estimated as increasing at the rate of 250,000 tons yearly.

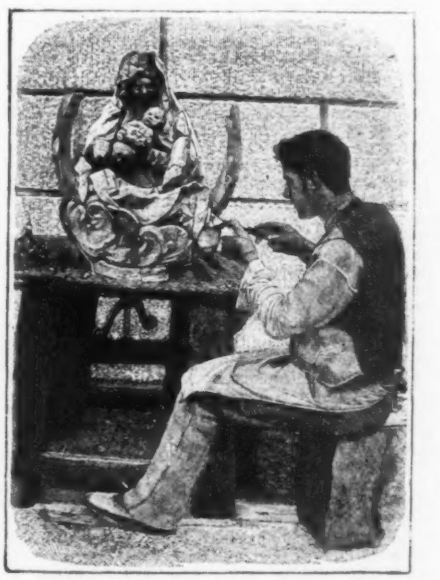
"The success attending the cultivation of sugar beet in this district has proved that it may be made a profitable and successful investment. A large factory has been built at Rocky Ford, Colorado, which cost $1,000,000 to build and equip. It is proposed to have it ready for the crop of the coming season. To supply it the farmers in the vicinity have contracted to grow 8,000 acres of beets a year for five years. From tests made they estimate their beets will yield 15 to 18 per cent of sugar. The factory, when running at its full capacity, will consume daily 1,000 tons of beets, which it will convert into about 100 tons of refined sugar of the highest purity. The beets reach maturity with a high percentage, and seldom go below 15 per cent; 12 per cent is taken as the basis of buying beets at the factory.

"The beets are grown by the farmers under contract with the factory, and paid for according to the saccharine contents determined by chemical tests made of samples taken from the wagons at the time of delivery. In addition, the factory controls about 5,000 acres of land. Most of the land will be farmed by tenants, but only a portion of each farm is devoted to beets each year. Growers sell their beets based upon the sugar contents. The tests somewhat resemble the assaying of ore from the mines. Selling upon this basis encourages better farming and the raising of better beets. It is the only fair way, both to the raiser and the manufacturer.

"At Sugar City a farm of 12,000 acres has been cultivated for raising sugar beets, and a sugar factory has been built with a capacity of 500 tons every 24 hours. On the farm 1,000 men and women have been employed during the summer, and this season's crop will be converted into sugar. The establishment of the sugar factory at this point built the town, which a few years ago consisted of a hut or two and thousands of prairie dogs. Next year fully 4,000 acres of beets will be cultivated. The output will be increased as rapidly as possible, and every day the demand for workmen is increasing.

"A general estimate of the cost of construction, cost of operation and general results to be counted upon, of beet-sugar factories in this district as taken from the Rocky Ford plant, places the general average of sugar in the beets at 12 per cent. So far as the Arkansas Valley in Colorado is concerned, this per-

INTERIOR OF A STUDIO.



A WOOD-CARVER AT WORK.

centage is being largely exceeded; the minimum percentage of sugar being about 14 per cent, while the maximum has reached 23 per cent, with a coefficient of purity ranging from 80 to 95 per cent. In stating these results, reference is especially made to the factory at Rocky Ford, built and worked by the American Beet Sugar Company, a New York corporation, which works two factories in California and three in Nebraska, the one at Rocky Ford being their fifth. The experts in charge of this last factory all express surprise at the results of this first campaign, and they have become thoroughly convinced that this valley (Arkansas Valley, Col.) is the ideal sugar-producer, thanks to its equable climate, ample supply of water for irrigation, cheap fuel and limestone, and an unlimited extent of available land for beet culture. It is expected that the same company will erect one or more factories in addition to the one at Rocky Ford, one to be built further east and the others west of Rocky Ford.

"As an example of the quality of the sugar beets produced upon this land, it may be mentioned that so far six car-loads of beets from one field have been tested with results as follows: One car-load, 16.3 per cent; three car-loads, 18.8 per cent; and two car-loads, 20.4 per cent."

PAINTING THE CARVED FIGURES.

STAGE BRIDGES AT THE COVENT GARDEN OPERA HOUSE, LONDON, ENGLAND.

THE Royal Italian Opera House, Covent Garden, London, has been the subject of material alterations and improvements, and these improvements include an entirely new equipment of stage mechanism, a considerable part of which relating to the stage proper is worked electrically.

In order to give the theater this new equipment, it was necessary to undertake considerable structural work, including the raising of the large roof, which has a 90-foot span to a width of 70 feet, no less than 20 feet of height having to be gained, and the roof in question being lifted bodily to its new position.

The whole of the work, structural, mechanical, and electrical, was executed from the designs and under the direction of Mr. Edwin O. Sachs, the technical adviser for the Opera House and author of "Modern Opera Houses and Theaters," whose works in other directions have been commented upon before in these columns, not forgetting his equipment at the National Theater, Drury Lane, London, where considerable improvements were undertaken a couple of years back.

At the Covent Garden Opera House Mr. Sachs divided his stage into what are termed "sections," i. e., horizontal sections running right across the stage from left to right and numbering six in all, followed by a back stage. Of these six sections, the first nearest the orchestra is not movable and simply has a number of openings in it to take traps and other minor mechanical arrangements, but the second, third, fourth, fifth, and sixth are all movable and can be bodily raised or lowered at will. The back stage is not movable, but contains some openings.

These movable sections measure 40 feet frontage, with 8 feet width or depth. They are constructed on the "bridge" principle in light steel lattice girder work, and are suspended on either side from three points by a system of cables, counter-weights and pulleys on stanchions, in accordance with the "Sachs patent" of 1898. Each section can be raised 9 feet above stage level, or be lowered 8 feet below it, and being counterbalanced within 2 tons, each section only requires 7 B. H. P. shunt-wound motors to drive the winding gear, which is centrally placed below each individual section to raise dead weight and a live load of another 2 tons.

The speed at which the bridges can be run can be varied to a nicety, as they are worked by a worm wheel with keyed shaft.

The stage proper, which contains these sections, was gutted on the 4th of January and handed over to the management three months after, the gutting being very complete and the whole of the structural work (both in relation to the mechanism and otherwise) having been remodeled and placed freshly in position and the whole of the machinery being new.

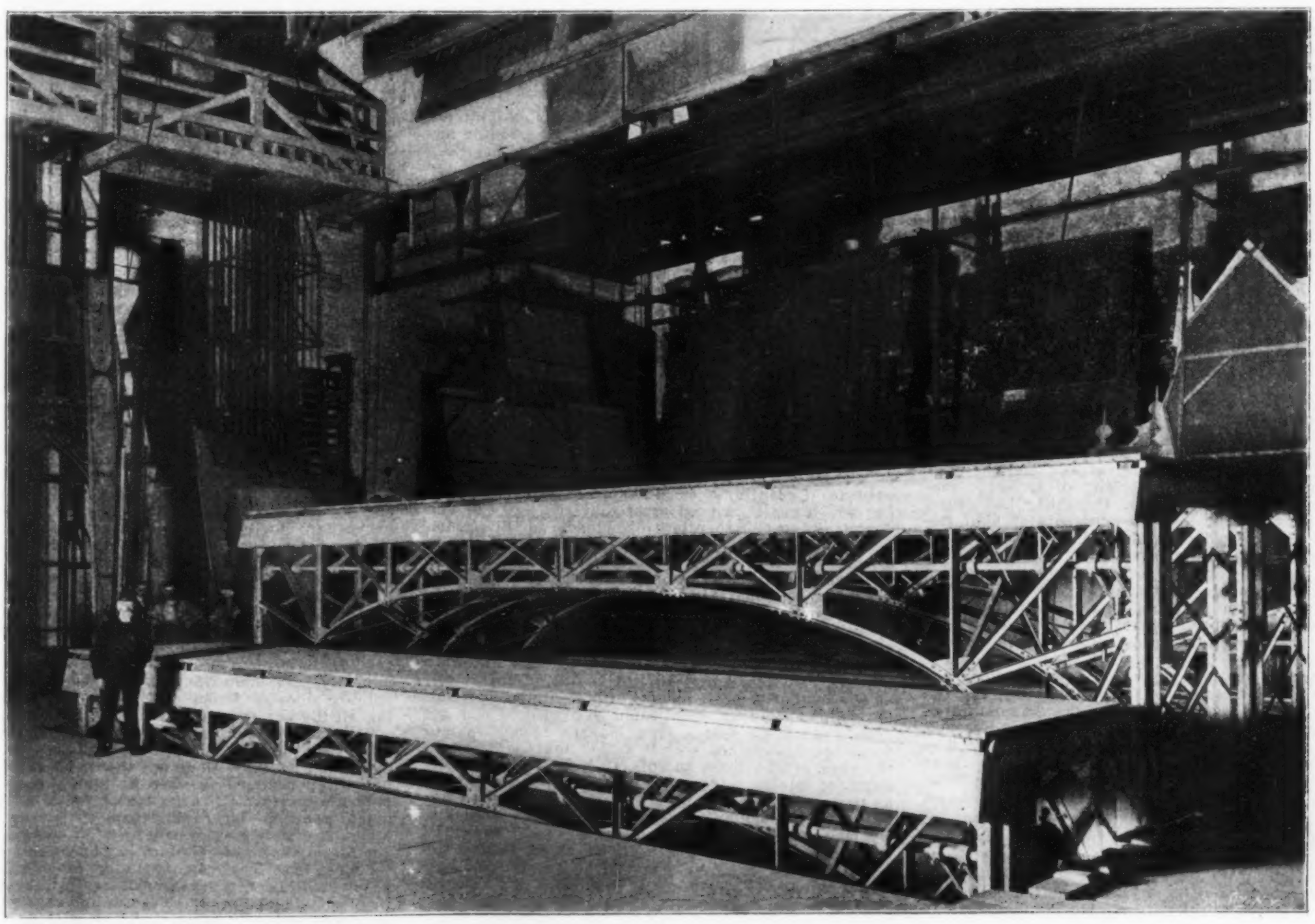
Only three of the bridges were required to be movable for the present opera season, or in other words, only three of the motors were installed for the present season, and a further two will be installed in the course of the present summer, the first two movable sections not having been required this year.

The economy of working the stage electrically has been found to be considerable, inasmuch as after the capital outlay has once been made the actual working expenses are almost nil, each performance requiring at the most the attendance of one weekly mechanic, whose pay may be taken at 30 shillings per week; the cleaning utensils and electrical current to the extent of about 4 cents per day, while the repair account is limited to the refitting of brushes to the motors.

The uses to which the movable sections of the stage are put are numerous and varied, but approximately the raised section is a rapid means of forming a raised background without the application of the clumsy wood rostrums which were formerly required. An enormous amount of manual labor is hence done away with, and the reduction in the ordinary scene-shifters' weekly bills may be taken to amply meet the interest on capital outlay. It is already, in fact, known that in the short opera season at Covent Garden the saving of the stage bill must have been substantial.

As is only natural with so large a new installation of stage mechanism, the scenic arrangements at the opera in London were the subject of considerable discussion and criticism during the current season, and many of the visitors to the opera were disappointed that the scenic effects were not up to the standard they had anticipated. This, however, was mainly due, first, to the fact of the stage having only been handed over to its owners a few days before the commencement of the season, and, secondly, to its having become necessary to dismiss the entire Covent Garden stage staff just before the opening of the season, the conservative British workman having apparently not taken to the modern appliances.

It will be easily understood what it means in an opera house with a repertoire of some thirty numbers played over a short season of some seventy nights to suddenly have an entirely new staff to deal with, quite irrespective of the question of entirely new equipment of mechanism, so it naturally occurred that much was wanting so far as the niceties of scenic effect was concerned. Added to this, the scenic inventory of the opera had been allowed to run down to a very bad state during the last ten years, with the unfortunate result that when it came to moving and rapidly handling these vast packs of material in order to make room for the new stage much that would have otherwise seen a little longer life went absolutely to pieces and the management found themselves short of many of the component parts for the scenic effects they required. It is, however, generally understood that the management are now seriously contem-



ELECTRICALLY-OPERATED STAGE BRIDGES, COVENT GARDEN OPERA HOUSE, LONDON.

plating a very large renewal of their scenic stock, that the staff are to be systematically drilled and the scenery systematically stored, so that if all is well Mr. Sachs should in the next season see the ample fulfillment of his ideals in scenic management, i. e., a practical modern stage equipment with an artistic modern stage outfit worked by a modern staff.

Mr. Sachs holds commissions to design similar stages in different parts of the world, his last design, in fact, being for one in India, and it is to be hoped that his introduction of electrical power as superseding hydraulic power may also lead to an extensive economic and artistic improvement in the stages throughout the world.

CONTEMPORARY ELECTRICAL SCIENCE.*

Dissipation of Electric Charges.—J. Elster and H. Geitel found some time ago that the conductivity of air for charges dissipated from a metallic body gradually increases in a confined space, tending toward a limiting value. Since it is known that air free from dust conducts these charges better than dusty air, the authors suspected that the increase of conductivity in question might be due to the gradual laying of the dust in the confined space. They, therefore, made special experiments with artificially cleaned air, which was either sucked through wadding or cleaned electrostatically. The attempt to produce the limiting conductivity by this process failed entirely. The time at which the maximum conductivity was attained could not be perceptibly shortened in this manner. The authors next investigated the effect of moisture. But even such large variations of percentage moisture as from 91 per cent to 7 per cent did not produce a decided result. The authors, therefore, suggest another and a very interesting explanation. It is that all substances either contain traces of radio-active bodies or are themselves slightly radio-active, and that the maximum conductivity is attained when the rays have had time to produce their full ionizing effect upon a certain quantity of air. The high conductivity of the air in closed cellars and in caves would tend to confirm this.—Elster and Geitel, Phys. Zeitschr., June 22, 1901.

Europium.—In his beautiful researches on electric fluorescence in a vacuum in 1885, Crookes mentioned a band which he attributed to samarium and which, on account of its disappearance in presence of calcium, as well as for other reasons, he called the "anomalous ray." In 1889, he attributed this line to some meta-element, and suspected the presence of other meta-elements as well. E. Demarçay, the discoverer of radium, has now identified this line with the spectrum of a new element intermediate between gadolinium and samarium which he calls europium, with the symbol Eu and an atomic weight of about 151. The best manner of obtaining the oxide is by fractioning magnesium nitrate. It is found that the line spectra, reversals, absorptions and electric fluorescence of the sulphate in vacuo all vary together with the condensation of the element, and therefore satisfy the criterium of elementary nature. The sulphate may be obtained in such purity that the samarium spectrum is quite invisible, and only a few of the strongest gadolinium lines show up. The fluorescent spectrum, which is brightened by the presence of calcium, consists of three chief bands, with wave-lengths of about 609, 593, and 576 respectively.—E. Demarçay, Comptes Rendus, June 17, 1901.

German Electrical Units.—The Reichsgesetzblatt has published the regulations laid down by the German Federal Council with regard to the determination and nomenclature of electrical units. The ampere, ampere-hour, watt, watt-hour, farad, and henry are the units, mega, kilo, milli, and micro are prefixes used as heretofore, and the effective current intensity of an alternating current is defined as the square root of the mean value of the squares of the instantaneous intensities. The conditions under which the silver is deposited in the silver voltmeter are strictly defined. As regards electric supply meters, it is enacted that the error of the meter may not exceed 0.6 per cent of the maximum current, plus 6 per cent of the actual current; or, if the actual consumption is only 4 per cent of the maximum consumption, 2 per cent of the actual consumption is added to the first figure. Provided always that in the case of light installations the consumption to be indicated does not fall below 30 watts. In the case of alternate or polyphase meters, where there is phase-difference, double the tangent of the phase-difference is to be added to the error (in percentage of actual consumption), as determined above.—Zeitschr. f. Instrumk., June, 1901.

Harmless X-Rays.—Röentgen rays sometimes give rise to mortification of the skin, and medical men have sometimes been prosecuted in consequence. When the tubes are driven by influence machines that does not happen, but then the activity is reduced, and the presence of moisture and the necessity of an earth connection may be awkward. R. Demerliac has found that tubes worked by alternate currents of high frequency and high tension never produce erythema, and that, on the contrary, the rays so obtained possess the curative properties recognized in electrotherapeutics since the experiments of D'Arsonval, Oudin, Doumer, and others. He therefore employs the Oudin resonator, which, with certain precautions, may be made to work X-ray tubes. They light up on connecting them with the upper knob of the apparatus. A broad concave cathode and a small anode or an annular anode are used. The cathode is joined to the resonator, and the anode may be left free or put to earth. The discharge is most effective when it proceeds in one direction only. A cathode valve should, indeed, be useful. The tubes may be brought quite close to the skin without risk, and thus any loss of penetrative power is effectually counteracted.—R. Demerliac, Comptes Rendus, June 24, 1901.

Energy Absorbed by Vacuum Discharges.—P. Cardani has recently followed up the interesting result of his previous work that the form of discharge in a gas is characteristic of its physical condition and independent of its chemical nature. He distinguishes 14 successive stages of evacuation, beginning with the ribbon-shaped spark at pressures from 650 to 320 mm. This is followed by a complete brush, a spreading brush, a luminous cathode (6mm.), the beginning of the dark cathode space (0.7mm.), the extension of the dark space over 8, 20, 35, and 50mm. respectively, white brush at the anode, wandering brushes at the anode, X-rays, and disappearance of luminosity. All these successive stages are reached at the same pressures in air, hydrogen, and CO_2. The maximum energy in proportion to the total energy is consumed at a pressure of 130mm., just where the spark gives way to the brush discharge. The minimum is when the cathode phenomena become well marked, and the dark space is about 8mm. long. On further exhaustion the energy rises again to near the maximum, but the appearance of X-rays is not marked by any discontinuity. If cathode rays are due to a special form of ionization, it follows that the energy required for generating the electrons is always the same.—P. Cardani, Phys. Zeitschr., June 29, 1901.

Globe Lightning.—J. Violle describes a globular lightning discharge as follows: "On Sunday, June 9, at 1:30 P. M., toward the end of a somewhat violent storm which passed over Fixin, near Gevrez-Chambertin (Côte d'Or), I observed a globe discharge under the following conditions: I was on a balcony facing the east, and thence I watched the thunderstorm, in which lightning flashes succeeded each other at frequent intervals, in the shape of fiery tracks slightly sinuous and nearly vertical, generally doubled, and about 2 miles away. Then, after an interval of several minutes, I saw a fiery ball which seemed to fall from the sky like a stone, in the same place where the straight flashes had been seen, and from the same height. After another interval the region in question was again illuminated several times by brush lightning, in the shape of diffused discharges within a limited space. I cannot attribute the phenomena to an optical illusion, as it was seen in the same manner by a person close by, who immediately exclaimed. I also made sure that no meteorite fell in the spot, though I was already convinced of the electric nature of the phenomenon. The phenomenon squares with the accepted explanation of the globe discharge as due to local heating of the track, except as regards the falling 'like a stone.'" —J. Violle, Comptes Rendus, June 24, 1901.

Anti-Coherers.—In reply to Neugschwender (see The Electrician, p. 396), E. Marx maintains that Schäfer plates do not act electrolytically, but by the evaporation and condensation of the silver bridges in the gap. In the first place the plates may be thoroughly dried without interfering with the signals. As regards Neugschwender's contention that the re-deposited silver would be in the form of oxide, the author points out that silver oxide is reduced by heating, and that any deposit must, therefore, be of metallic silver. The deposit will be confined between the silver mirror and the celluloid film, and will, therefore, be re-deposited in the gap made by the razor. But the crucial fact is that anti-coherers may be constructed by simply having a narrow bridge over the gap which is not destroyed by the impact of electric waves. In this case there can be no question of electrolytic action. What probably happens is that the bridge acts as a bolometer wire, its resistance increasing with the rise of temperature produced by the impact of the waves. This observation suggests the possibility of constructing bolometers which may fulfill all the functions of coherers, or rather anti-coherers, besides being "self-righting."—E. Marx, Phys. Zeitschr., June 29, 1901.

* Compiled by E. E. Fournier d'Albe in The Electrician.

THE CULTURAL VALUE OF ENGINEERING EDUCATION.*

By Prof. Frank O. Marvin, University of Kansas.

At the very outset of this discussion is encountered a great difficulty. What is culture? The writer has been asking this of his friends. An answer has been sought for in the printed page where is recorded the best thoughts of the best minds. Great thoughts and lofty ideals have been disclosed, but nowhere has been found a satisfactory definition, a phrase or paragraph that succinctly and clearly sets forth the heart of the matter.

People often recognize, appreciate and reverence its possession without being able to fully analyze and set down its elements. There is something subtle and emotional about it that eludes a close pursuit.

The reason for this, perhaps, lies in its essential individual quality, in its being the result of a personal life, developed, it is true, on lines similar to those used in other lives, yet including something that pertains exclusively to the human unit that is different from all other units.

Nevertheless, there seem to be certain fundamental qualities which must be possessed before a man can be classed with cultured people, qualities which are only acquired after a considerable experience in life, but which are influenced greatly by the years of student training and therefore fit subjects for discussion here. Far be it from the purpose of this paper to attempt a definition of culture or a setting forth of its elements in any completeness; rather the emphasizing of some things that relate to it, especially with reference to the education of young engineers.

First: The man of culture must be a thinking and reflecting being. There must be not only the ability, but the habit; and this is no easy thing to acquire. Modern American life is full of hurry, full of affairs that demand instant attention, and one matter follows another with rapid succession. We get news from Pekin to-day, from Havana to-morrow and from the Philippines within a few hours. We build railways, erect bridges and fill large orders for locomotives for foreign shipment in such short space of time as to asonish the world. Men seek short cuts to fortune. In the popular opinion, the men who act quickly, the men of decision, are those who succeed. But there is a danger here. For, back of the action, behind the sharp decision, must lie a mature judgment, and how else is this to be formed except as a result of deliberate reflection. However quickly one may reach a conclusion, its correctness or faultiness will depend not on intuition, but on the degree of true comprehension. The decisive act which is also right rests on a process of thinking and judging that has been long fostered, until it has become a habit, until there are established certain standards by which things are to be measured. The early steps of this training are necessarily slow, and we, as teachers of engineers, must recognize this and not yield to the temptation to crowd our students over too much ground on the one hand, or, on the other, to lead them through short cuts across country by empirical paths that may give them ease and quickness of travel, but little or no reason why the path is chosen. Let them go the long road. I do not by any means wish our teaching to be non-practical —rather more practical in the best sense; but first, last and all the time, let students be trained to do their own thinking and to form their own judgments; to test the statements of others by the workings of their own mental processes.

Second: There is another element of culture that comes in here, an ethical one, that of forming right judgments. Men may have the appearance of culture without its true spirit, which is essentially honest. This is especially important, as culture seeks to make a man's life satisfactory to himself when measured by his own conscience, as well as successful in the field of affairs. So his standards must be based on sound principles of right and wrong; and it is only when these are so placed that his life becomes one of freedom, freedom from the bondage that wrong thinking and acting always bring. A class room is no place to preach a sermon, but there can be there imparted a respect for truth and perfect honesty. A teacher's attitude should always be open and frank, that of a sincere seeker after truth. He should never dodge an honest question, and be ever ready to say "I do not know" if he does not. There is an incalculable power that "makes for righteousness" and the happiness of the after life of the student in the true teacher's conduct of even such a material subject as mechanics.

Back behind the subject with its subdivisions, its formulæ and rules, lies something larger, a sort of spiritual quality that binds it to all other subjects, to the universe as a whole, and makes it a part of the truth of God's realm. The student that gets hold of this significance learns much more than facility in the manipulations of processes or the application of principles. He gets something that makes his life richer and better and his mastery of the subject more complete.

Third: There can be no true culture for a man that does not work, that does not put his cultivated powers to some useful service; and here there must be such degree of mastery over the chosen profession or business as will result in a special skill and dexterity—a doing of some one thing better than others can do it. A man expresses himself through his work, and whether he will or no, he thus discloses to all who know him his own peculiar qualities. It is this intensity of application, this concentration of purpose and directness of aim, that gets the world's work done. Here in early years the engineering student has the advantage of the student in arts. Study for knowledge's sake may be stimulating to the few, but for the many there is needed the goal of a special calling to secure the close application that results in ability to concentrate one's energy to the attainment of a certain end. But here again comes a danger, that of too early, or over, specialization, and the following of short cuts to professional life that are advocated by some who, in the eyes of the world as well as in their own, have been eminently successful as specialists. Whether these can be called men of culture of the highest attainments is another matter. The extreme specialist may be supreme in his own line of details, but may fail when there comes up a question involving the relation of his specialty to other things. Even within his own domain, his conclusions will be modified by his general knowledge and experience. All one-sided people, whether they be linguists or naturalists, poets or merchants, preachers or engineers, are quite liable to the forming of erroneous judgments. To the few geniuses, whose capacities and powers seem to be abnormally developed, though of limited scope, much is forgiven; but for the average man of the day there is demanded an ability to form good and wise conclusions.

Fourth: In order to form those that are appropriate and correct there is needed, then, breadth of view—a quality that has been expressed by the word poise. A man of poise, of even balance, will see things in their right relations and due proportions; he will weigh matters, giving to each component part its just degree of importance. He will the better understand the motives that underlie other men's actions and the more readily use them to suit his own purpose. He will be more apt to rightly interpret the new movements in the world of thought or action and can seize opportunity for a personal advantage or a larger sphere of service before others see that there is such.

This demands a considerable range of knowledge. Not the close mastery of many lines in all their details, but a fair degree of familiarity with their general phenomena and principles; and there is scarcely any field that will not contribute something to the result. It is admitted at once that the average man is of limited capacity and unable to grasp a comprehension of all knowledge that may influence his life and work; what is pleaded for is such degree of breadth as may be needed to make one of great efficiency in his chosen profession and of most value to himself, not only in a financial way, but also in the sense of gaining a joyful recognition of the worth of developing all the powers that one has.

The value of mathematics and the physical sciences with their applications to technical things needs no discussion here, for these are the engineer's tools; but it is a fair question whether, in our desire to graduate students that can be early useful, we do not place too much stress on technical things to the exclusion of others that give greater breadth of training. We must not forget that we are educating men for a life; that we must look forward to the time when these young people will be fifty years old, and at the period of their maximum productiveness and as workers of maximum value in society and as citizens.

Engineers have to deal with other things besides

* Address of the President of the Society for the Promotion of Engineering Education, Buffalo meeting, June 29, 1901.—From Science.

materials and physical laws; they must manage men and matters of finance. If they are to rightly influence those whose capital they are employed to expend, they must be able to meet them socially and intellectually, to discuss intelligently matters outside the pale of strictly professional life. Evidence of professional ability and skill is, of course, first demanded, but breadth of culture creates an added confidence in the wisdom of the conclusions reached and the advice given.

Heretofore much of our engineering work has been concerned with the opening and developing of new country or new business and industrial enterprises. So engineers have found their work away from contact with men. But engineering practice is changing, as conditions become older and more settled, and more and more practitioners find their work in communities and busy centers of trade where they are constantly thrown into close contact with strong and cultured men. Present engineering courses do little to prepare a man for this thorough instruction concerning human nature and human relations. Something of history, economics and sociology should be included.

Fifth: It is not sufficient to form correct judgments only; there must be added a skillful and effective presentation of them in well-chosen and fitting English. The ability to do this involves more than training in the writing of compositions, themes, forensics and reports. The cultured man should have a taste for reading the best that has been written in his mother tongue, and for several reasons: The great thoughts of great minds are stimulating and broadening to his own mind; he thereby absorbs a knowledge of words and their shades of meaning; he gains an appreciation of style and insensibly better knows how to form his own; and, not least by any means, he makes of his books friends that are life-long, that cheer and console him under all happenings, adding much to his internal resources for happiness.

The time given to English in our courses is not enough to train students properly in its use and at the same time open the doors to our best literature. It may be said that all this English work should be done in the preparatory school, and it is probably true that the character and quality of the high school English is better to-day than it has been heretofore. Yet it seems to me that engineering students should have some training of a college grade along the line of literature.

Sixth: To the writer's mind, there is another element of culture that should enter into an engineer's training, viz., an appreciation for beauty. As he has said at another time* the engineer is a designer, and it is important that he should embody his design in artistic form if he is to fulfill his whole mission and please and gratify others by the perfection of his work. The engineering student devotes a good share of his time to the drawing-board, and much can be done here toward the cultivation of this quality by an instructor who possesses it, without lessening at all the amount or force of the technical exercises for which the process is primarily used. There should be, however, something further by way of giving instruction in elementary æsthetics and by opening the students' eyes to what is beautiful in nature.

Seventh: The possession of agreeable manners and tact is another evidence of culture. Not merely the conventional bearing of polite society, though this has its value. This alone is but a husk which must cover the real kernel, refined and gentle feeling; and such feeling is the result of moral and intellectual convictions. Manners, then, are not to be taught from a text or by lecture; they rather follow as a consequence from the whole course of training and are crude or refined, just as the character of the instruction makes them. The teacher's personality has very much to do with this matter. If he is of coarse grain, of domineering or selfish disposition, his influence will not tend toward the production of true gentlemen.

And now for the real question—does engineering education tend to produce culture? According to old standards, when men limited culture chiefly to a knowledge of language, literature and philosophy, the reply would be in the negative. However, standards are not the thing itself, only methods of measurement; moreover, standards change. Science has modified and is still changing the ideas of culture that men hold, and this evolution makes it all the more difficult to find a common ground upon which all can stand when considering things concerning it. This much is clear, however, that no one existing course of educational training has a monopoly of cultural methods; nor will the completion of any college course necessarily secure its attainment, because of its personal quality. Further, culture is the result of a life, and the most that can be expected of a college course is to open the students' eyes to its real worth, to start them rightly with certain leanings and aptitudes, and furnish them with the means of a continuous growth toward its maturity.

It is maintained that an engineering course can tend in this direction, and that in some of our best colleges, under the instruction of people themselves cultured, it does so tend to-day. Our best engineering courses are stiffer and more exacting both as to time and effort than those in the college of arts, and the resulting acquisition of mental power and the ability to focus it proportionately greater.

The fixed course with its correlated parts and the certain definite end to be striven for are advantageous. The training is a continuous testing and trying of the truth of knowledge, and teaches the student to ask "why" and to reflect. He gains respect for nature's laws, and learns that his professional success will depend on his ability to work in harmony with her. He gathers a fair degree of knowledge of himself, his strong points as well as his limitations. He acquires a habit of thought and action that leads to further growth. He learns how to adapt means to an end, and within what limits of precision to work that it may be reached with economy. In short, he becomes a trained and educated man, cultured to a certain degree, but with limitations; just as the arts student who has specialized to a like degree in language and literature, with little of science training, becomes cultured, but also with limitations. Let the latter retain his A.B. On the other hand, let it be recognized that the engineering B.S. stands for culture as well, of equal worth and value, though of different kind.

As between the two specialists, I think the advantage lies with the engineering graduate as being on the whole better equipped for a life of useful service and one that will possess the greater capacity for further development.

As one looks forward ten or twenty years and attempts from present tendencies to forecast the work and social standing of engineers, he must see that the profession will be doing a larger work and exerting a greater influence.

Further, that an engineering training will be more and more recognized as the one best fitted to lead to positions of an executive nature in connection with industrial enterprises, and in the administration of public works. Everywhere will be demanded expert skill, sound judgment and broad views, primarily because these will be found to be economical. The entire class of men that a recent writer has called "mattoids," the ill-trained, narrow and egoistic, will be pushed out because their service is costly.

There are two tendencies in the present-day engineering education that are, in my judgment, opposed to the desirable result. First, a tendency to crowd too much of the foundation work back upon the preparatory school, already overloaded. This society's Committee on Entrance Requirements has advocated a standard which is high enough. Second, the allowing of technical subjects to crowd the fundamental general ones from the college course, in a vain attempt to do what from the very nature of the case cannot be done, make an engineer by college study. The result of this in some institutions is further seen in too early a differentiation between the various engineer-courses; so that, for instance, the civil student knows nothing of applied electricity and the electrical student knows nothing of surveying, while neither has a chance to acquire a taste for literature.

The whole problem is an involved and complicated one, but there is a way out that must be found if the engineer is to fill the important place that awaits him. One part of the solution will be probably found in a refining of the methods of instruction, so that better results may be reached in the same time. In the end, however, the writer thinks that there must come a deeper sense that after all life is long, that it should be taken with more of deliberation, and that it is the end that is important, rather than the beginning. The feverish rush and haste to be earning must be replaced by a recognition of the real necessity for a full rounded-out preparation if the largest and best service is to be given. Then the student will be glad to spend the one or two extra years in college that may be demanded. The wise student now will do this without its being required.

The Chief Justice of my own state has said, "The spirit of an age is that which makes finally for the happiness of the race. I have absolutely no fear as to the final end of things, nor as to the steps and incidents of evolutionary development. The aspirations, the great universal possessions of a people, can never move them to other ends than their happiness and good. The spirit of this age is commercial enterprise and conquest, and as to it I have an unspeakable conviction that it will, as the spirits of other ages have done, work itself into forms and institutions of beauty and eternal worth to men."

It is largely through the engineer that this is to be done. The finest result requires the most skillful labor; the noblest workman demands the most fitting training.

Herein lies our responsibility!

* Proceedings of the American Association for the Advancement of Science, Vol. 45.

THE CIRCUM-ETNA RAILWAY.*

THE Circum-Etna line is one of the latest and most successful engineering feats which have been accomplished in Italy. That the undertaking was an arduous task, apart from its inherent technical difficulties, can only be fully realized by those who have had the misfortune to struggle through the intricate maze of Italian bureaucracy. The preliminary red-tapism once over, the projectors had to face the very considerable material obstacles which the nature of the ground presented. The upper strata in many parts, and for wide tracts, consists mainly of lava beds; so that four years of laborious efforts were required to complete the work, although the total length of the line is only 114 kilometers (about 71 English miles). Of these 114 kilometers, about one-third lies through granite-like lava, which had to be excavated.

Thanks to the courtesy of Mr. Thrupp, one of the directors, to whose energy the success of the undertaking is largely due, I was enabled to make a trip over the line under the most favorable auspices. We started from Catania, from the Borgo Station. The first portion of our route lay through the luxuriant zone of vineyards, cornfields, orchards, and orange groves which encircle the greater part of the town. On emerging from the green belt, we entered what might be called the *regio infelix*, or barren lava region, gray, rugged, and treeless. The line runs for mile after mile between huge bowlders or embankments of lava until Belpasso is reached, where cultivation reappears, the underlying lava only cropping up at intervals. The devastating results of the great convulsion of 1669 are still visible everywhere.

The first place of note on the line after leaving Catania is Misterbianco, a town of about 8,000 souls, which was destroyed by the earthquake and eruption of 1669, together with some 14 towns and villages; hence it has quite a modern look among its dingy patrician neighbors.

Leaving Misterbianco, we presently reached Paterno, according to many the ancient Hybla Major, so celebrated in the days of old for its exquisite honey, which rivaled that of Hymettus. Paterno has succeeded to this portion of Hybla's inheritance and is moreover remarkable for certain Liliputian volcanoes which emit mud impregnated with salt. There is also a ferruginous spring here, whose waters are much appreciated in Catania. The town, which has 18,000 inhabitants, is fairly well built.

Aderno, which comes next, possesses the great charm of a waterfall, the falls of the Giarretta, the ancient Simetus, which is a river of quite imposing dimensions for Sicily, where the dearth of running water detracts so much from the beauty of the scenery.

Passing Aderno, we come to Bronte, which is quite a modern town, built by the Emperor Charles the Fifth of Germany. Bronte has been more than once menaced by lava torrents, and was in great peril during the two eruptions of the years 1832 and 1843. Half an hour more brought us to Randazzo, whose turrets, towers and churches give the town the true mediæval touch. It is the only city, or very nearly so, of all those which encircle Etna, which has been spared by the lava stream.

Castiglione, or Castrum Leonia, which we sighted next morning, is perched on a craggy height.

From Castiglione we proceeded past Linguaglossa to our last station at Giarre-Riposto, a flourishing little place of about 22,000 souls, from whence Catania or Messina can be easily reached.

The practical utility of this line to the Etna region is unquestionable, traversing as it does a most densely-populated district, whose products are now placed on the markets of Catania and Messina and other cities with much saving of expense and time. It also affords great facilities to the yearly increasing number of tourists who visit Sicily, giving them easy access to some very picturesque and historical spots.

This trip fits in so naturally with the beaten route followed by most travelers in Sicily, which lies through Messina, Taormina, Catania, Syracuse, and Girgenti, that, without omitting any of the well-known places, the tourist need only leave Messina or Taormina to take the Circum-Etna line at Giarre-Riposto and rejoin the main line at Catania. The extra expense, including a night at Randazzo, would not probably exceed twenty lire or francs. It is to be hoped that so much labor and enterprise in the right direction will not continue to be ignored and unappreciated, and I shall deem myself fortunate if I have been able by these few jottings to render both the work and its results better known to the public, to whom this knowledge would open a new and interesting route.

* From the Messina Correspondent of Sell's Commercial Intelligence.

CENTENARY OF THE FIRST ENGLISH RAILROAD ACT.

ALTHOUGH England is undoubtedly the motherland of railroads, its press entirely ignored so interesting an event as the centenary of the passing of the first railroad act. This received the Royal Assent, by commission, on May 21, 1801, and was for the construction of a line from Wandsworth southward to Croydon, called the Surrey Iron Railway. The line started from the east side of a small creek or inlet on the south side of the Thames, adjoining the mouth of the River Wandle.* A dock and wharf with an inner basin, which is still in use, was formed here, the railroad running out at the south end into Red Lion Street. It crossed the High Street, passed twice over the Wandle on wooden bridges and came into Garrett Lane opposite the Waggon and Horses Inn. From there it continued along the lane as far as Summerstown. The lane having been widened, now includes the site of the line most part of the way. From the Plough Inn, at Summerstown, the course is now that of Mead Path till the London and Epsom high-road is reached just above Merton. The old railroad crossed this on the level and went straight on to Mitcham in the line of the present right hand road. From the bend it went by Baron Walk and turns up on the south side of Mitcham station as a lane called Tramway Path. This soon becomes occupied for about a mile, by the existing railroad from Wimbledon to Croydon. From near Beddington Lane station the route of the Surrey Iron Railway led across Mitcham Common and the fields, and cannot now be traced, but from Waddon Marsh Lane near the present railroad it ran past the site of the Croydon Corporation's Electricity Works and ended about where the Gun Tavern now stands, a little north of Croydon Parish Church. These particulars will enable anyone to follow most of the route of the old tramroad, but no trace of its works remains. The country is nearly flat, so that none of importance were required. The rails were cast iron plates, 36 or 38 inches long, resembling the letter L in section, resting upon stone blocks, 8 or 9 inches thick and 15 or 16 inches square. The two rows of L's being back to back,] [, it is plain that common carts could use the railroad, while railroad tracks could use the highway. The tread of the plates was 4 inches wide, the flange being hog-backed, about ½ inch thick. A rib was cast underneath also, for additional strength, the weight of the plates being 40 pounds each. They were secured to the blocks by a square-headed spike at each end, fitting a notch with sloping sides in the ends of two rails. The head of the spike was, thereafter, countersunk, so as not to obstruct the wheels. Wooden plugs or trenails in the blocks were required to give a good hold to the spikes. The railroad was a double line, with cross-overs here and there and probably a few sidings for local traffic. No passengers were conveyed; it is even doubtful if the company possessed any rolling stock. The trucks used on the early tramroads belonged generally to carriers who let them for hire, or to traders along the line. Anyone, however, could use the railroad on paying the tolls, if his vehicles were not likely to injure it. Most of the trucks, which were very small, weighed about one ton and carried three, on cast iron wheels some 30 inches in diameter, running loose on the axles.

As to the motive power of the establishment, it was not of an imposing order. Miserable teams of half-starved and worn-out horses, donkeys and mules constituted the locomotive department. What little traffic there ever was, and the line was a deplorable failure from first to last, consisted of coals and manure brought to Wandsworth by river, and in the other direction lime, fuller's earth and stone carried down

* West of the Waterloo terminus in London of the London & South-western, Wandsworth being the next station beyond Clapham Junction.

from Merstham to Croydon by a similar railroad belonging to a different company. This other line, which was sanctioned in 1803 and opened two years later, has left considerable remains alongside the Brighton Road at various points south of Croydon. It rejoiced in the long-winded title of the Croydon, Merstham and Godstone Iron Railway. Not that it ever went to Godstone, though it intended to; but the most interesting fact about these curious old tramroads is that they were really portions of an abortive scheme for connecting London and Portsmouth. Such lines were often made in lieu of canals where water supply was deficient. Many canal acts conferred power to make short bits of railroad, but these were altogether subsidiary to the waterway and regarded as inferior to it. In this case, though efforts had been made to get a good line of inland navigation to Portsmouth, and the Croydon Canal was made as the first part of one, the Surrey Iron Railway Act was for a railroad alone and was not connected with any canal scheme. It was thus undoubtedly the first railroad act pure and simple.

The line was formally opened on July 26, 1803, when the committee, or board of directors as they would now style themselves, proceeded to Croydon in wagons drawn each by a horse. Doubtless the wagons were quite indispensable for bringing home the worthy committeemen, as they dined at the King's Arms and spent the day "with the utmost conviviality." Most of the committee were local manufacturers, for in those days the River Wandle provided power for a great number of calico-printing works, oil mills and snuff mills. These latter were very flourishing, as everyone, from George III. to Queen Charlotte downward, took snuff by the handful. A sprinkling of bankers and city men completed the directorate, but as only links in a long line never carried out, both the Surrey and Merstham companies were foredoomed to failure.

The distance by the Surrey line from Wandsworth to Croydon was about 8 miles, but there was a branch from Mitcham Common to some mills and works on the Wandle at Hackbridge. The course of this branch lay along a continuation of Tramway Path, coming out at the Goat Inn at Beddington Corner. One or two sidings into other works existed, the whole length of the system being as nearly as possible 10 miles. It was laid out by William Jessop, who undoubtedly succeeded Brindley as the foremost canal engineer of those days. The firm of Outram & Jessop were also iron founders on a large scale at Butterley, in Derbyshire, where the works they established are still flourishing. Benjamin Outram's father invented rails or tram plates of the kind just described and first laid them on a colliery line at Sheffield, owned by the Duke of Norfolk, in 1776. The rails of the Surrey Iron Railway came from Butterley, and the stone blocks, about 61,000 in number, from quarries at Cromford, near there, belonging to Outram.

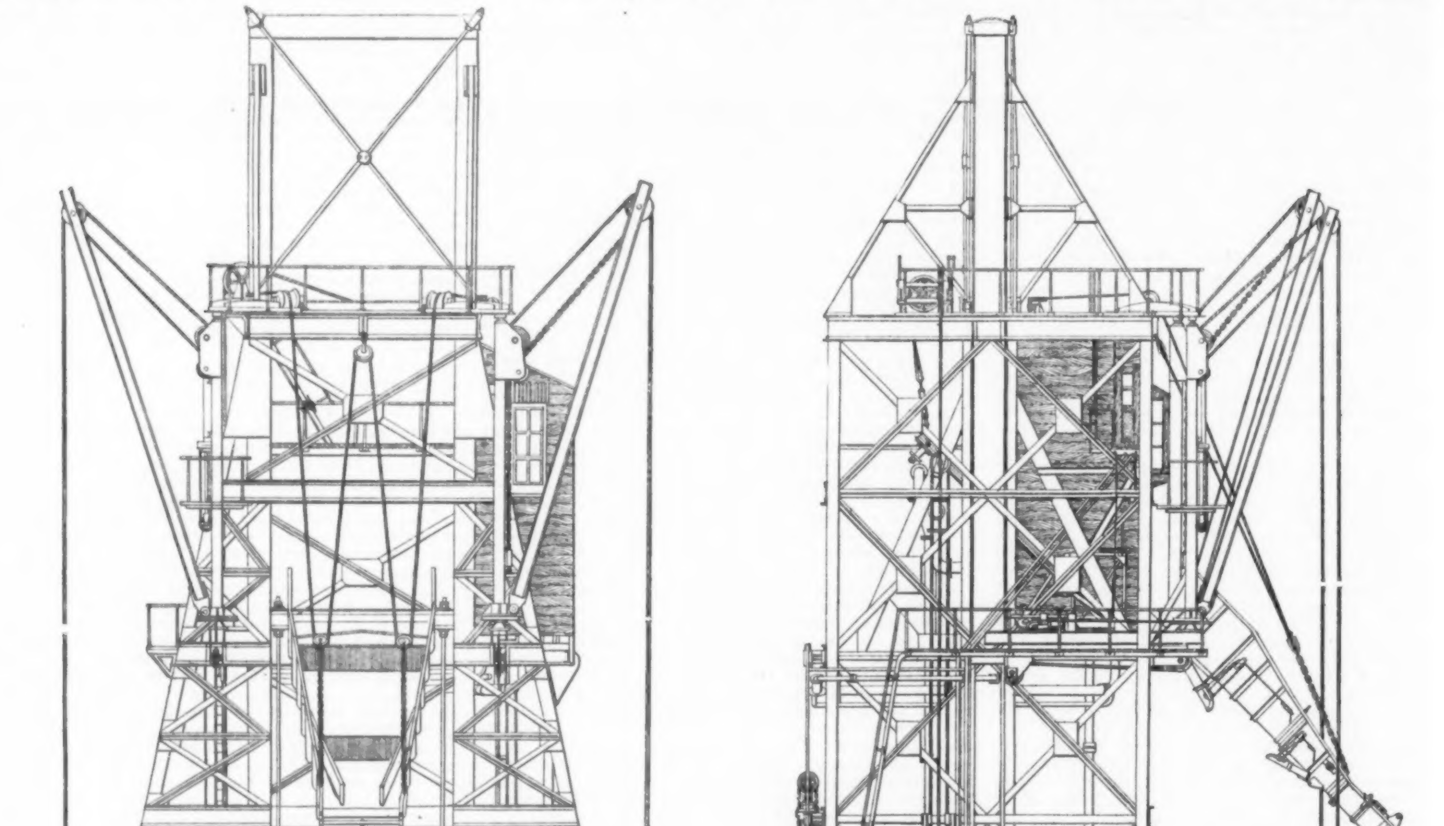
The Merstham line being purchased by the London & Brighton Railway Company, was closed by them in 1838, whereby the ruin of the Surrey Iron Railway was completed. After lingering on in a practically abandoned state, it was closed for traffic on August 31, 1846, the materials taken up and sold, the wharf and premises at Wandsworth finally coming under the hammer on June 8, 1848. Two months later, on August 3, the company itself ceased to exist. Such was the melancholy fate of the first public railroad.—W. B. Paley, in The Railroad Gazette.

THE NEW PENARTH COAL TIPS.

THE important additions the Taff Vale Railway has made to its shipping facilities at Penarth Dock were formally opened on July 26, with eminently satisfactory results.

The proceedings took about two hours to follow; little more than two sentences should be sufficient to say what was done. It was full neap tide about 1:30 P. M.; with spring tides the circumstances would have been more favorable if less of a testing character. The steamship "Bangarth" entered the basin at 11:45 A. M., and moored under one of the new tips to take in 50 tons of bunkers, which was accomplished in exactly 8 minutes. By 11:55 the steamer had taken up position under the four shoots, and loading went on without difficulty or intermission until 1:55, by which time she had taken in her full cargo of 2,154 tons 14 hundredweight, and was free to put out to sea on her voyage to Liverpool. The patent "dispatch" bucket, holding 5 tons, was only employed in the preliminary stages of loading. When this ingenious appliance had completed its work by depositing its pyramidal heaps in the hold, its use was discarded, and the rest was left to the wagons and the shoots, which the hydraulic machinery of the tips and the staging manipulated with something very like clockwork precision. It was noticeable that while the tips are automatic in the sense that one man in the "crow's nest" can govern each of them by moving a lever, the operations on the platform and sidings required more than the automatic machinery and pressure, a good many dockmen being engaged with hauling and guiding ropes in directing the laden wagons to the approach to the shoot. This is, it was explained, inevitable where, as on the east side of the dock, there is no means of constructing high-level sidings; but it prompted the thought that the complicated rope and tackle arrangements might be dangerous on a dark or foggy night. Again, the discharged wagons pass by gravitation along a siding of no very heavy gradient; but the sound of the concussions was distinctly suggestive of a good deal of wear and tear. Mr. A. Beasley, the Taff Vale general manager, and Mr. T. Hurry Riches, M. Inst. C.E., the locomotive superintendent, and designer of the tips, believe that the last-mentioned difficulty will be overcome in a few months' time, and point out fairly enough that even where there are high-level lines of supply the "bumping" of the trucks is just as conspicuous when they are sent empty on to the lower sidings.

At the luncheon, after the trials, Mr. Vassall mentioned that fifty years ago the total revenue of the Taff Vale was less than £1,000 per week, while now the company showed a return of £20,000 a week, and carried 15,000,000 tons of coal alone yearly. Mr. W. H. Lewis, president of the Cardiff Chamber of Commerce, pointed the contrast between the loading of the steamship "Bangarth" and the time he remembered when to have placed 1,000 tons aboard in two days would have been considered a remarkable performance.



NEW COAL TIPS AT PENARTH.

Mr. Charles Thomas, referring to his recollection of the cutting of the first sod of the first dock in Cardiff, stated that he was sixteen hours on the water in those days crossing to Cardiff from Bristol. But of more current interest probably are some statistics, supplementary to those of Mr. Vassall, which Mr. E. Edwards, secretary of the Taff Vale Company, is good enough to supply. There was an impression that the Penarth Dock and Harbor had been the neglected child, and a costly one, of the Taff Vale directorate. To show this idea is contrary to the facts, he sets out the coal shipments for the past five years as follows:

	Dock. Tons.	Harbor. Tons.
1896	2,590,574	225,634
1897	2,871,952	178,576
1898	1,823,392	129,871
1899	3,189,330	178,879
1900	3,106,272	146,985

These figures speak for themselves.—The Engineer.

A LUBRICATION REGULATOR.

WITHOUT passing in review the different apparatus proposed by inventors for obtaining a proper lubrication, it may be said that all those now in use present the inconvenience of furnishing a lubrication of which the intensity varies with the differences of height of the lubricant in the cup that contains it. It will be understood, in fact, that if we employ an oil cup regulated for an output of a certain number of drops of lubricant per minute, the difference of pressure resulting from the diminution in the weight of the liquid contained in the cup will bring about a slackening in the flow of the oil. In like manner, and especially in siphon lubricators, the quantity of oil conveyed by capillarity to the part to be lubricated will continue to diminish in measure as the level of the oil lowers in the cup into which the wick dips.

M. Caloin, a machinist of the merchant marine, has, through a very simple arrangement, surmounted the difficulty and assured the constancy of the level of the oil in the collectors that are generally arranged upon all ships and that are designed, through a system of pipes, to assure the lubrication of each of the joints.

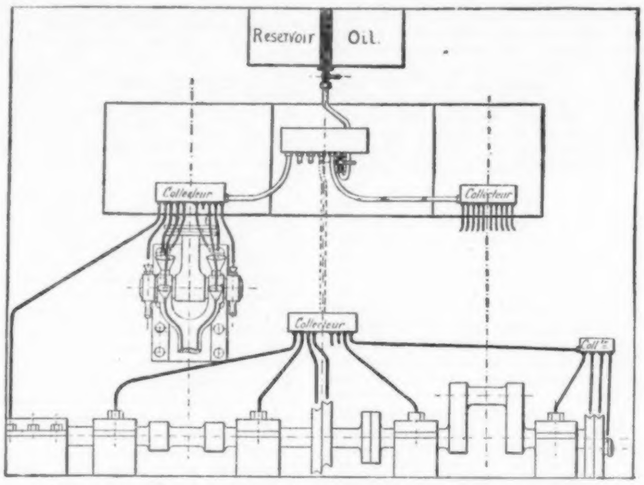


FIG. 1.—DETAILS OF A LUBRICATING INSTALLATION.

Fig. 2 represents an apparatus of this kind that has been in use for a year upon several ships of the Compagnie des Bauteaux à Vapeur du Nord, and that has given the best of results.

As may be seen from Fig. 2, the apparatus comprises a rectangular box divided into two distinct compartments, *E*, *F*, by a vertical partition, *G*. The compartment, *E*, to the left of the figure, contains a certain number of conduits, *J*, *J*, *J*, widened at the top and corresponding to as many couplings screwed into the bottom of the compartment, *E*. The oil drawn into the compartment, *E*, by the wicks, *H'*, *H'*, is led by capillarity into the conduits, *J*, *J*, *J*, and is conveyed thence by pipes to the collector for which it is designed.

The wicks under consideration are composed of several threads of merino wool independent of one another. These threads are passed through a metal ring, the weight of which holds them by the middle in the tube in which they are to perform the rôle of siphons, while their extremity enters the oil of the cup and sucks it up by virtue of the phenomenon of capillarity. We know that the number of drops of oil furnished by each thread of wool in a minute will remain exactly the same if the level of the oil remains constant in the reservoir. It suffices, therefore, to give the wick a number of threads corresponding to the quantity of oil necessary. A wick of 30 threads will give three times more oil than one of 10 threads. This proportion is mathematical.

The oil is conveyed automatically by the pipe, *K'* from a reservoir containing a quantity sufficient to lubricate the engine for a very long time, and placed above the distributing apparatus (Fig. 1). The cock, *K*, permits of the entrance of the oil or arrests the flow of it, according as it is opened or closed.

By reason of the weight of the oil and the difference of level existing between the upper reservoir and the apparatus, it was necessary to oppose an obstacle to the entrance of the oil when the level, fixed in advance, had been reached in the compartment, *E*. To this effect the cock, *K*, carries a seat, *L*, upon which rests a valve, *L'*, which, through the intermedium of a lever, *M M'*, is raised or lowered by a metal float, *Q*, housed in the compartment, *F*.

The two compartments of the apparatus communicate with each other through a straight tube, *H*, *H*, open at each end. This begins at the partition, *G*, which it traverses and runs along the bottom of the compartment, *E*, as far as to its center. This arrangement obliges the oil to flow gently into the compartment, *F*, where it lifts the float to the level determined in advance. In this motion the float raises the arm, *M'*, of the lever, while the arm, *M*, causes the descent of the valve, *L'*, which forms an obstacle to the passage of the oil. As soon as the wicks have sucked up a small quantity of oil, the level of the liquid lowers in the two compartments, and the float, in descending, carries along the arm, *M'*, of the lever, which through its arm, *M*, raises the valve. The oil can then enter the oil cup anew until the determinate level is reached.

The maneuvering is of the simplest character and is effected automatically. It is well to remark that since the oil can enter the compartment, *F*, only by passing through the middle of the compartment, *E*, the float cannot be influenced by the changes of level produced by the rolling and pitching of ships, the level of the oil in the middle of the cup always keeping at the same point.

The inventor of this apparatus has assured the position of the float by means of a square guide, *I*, fixed to the bottom of the compartment, *F*, and which enters a socket, *V*, of the same form arranged at the lower part of the float in such a manner as to assure tightness, and, on another hand, the jointed rod that connects the float with the lever arm, *M'*, is provided with a thread of a pitch of 0.04 of an inch, and this, through a nut with a thread of the same pitch as that of the rod, allows the float to be raised or lowered to the desired degree, so as to change the level of the liquid in order to increase or diminish the intensity of the lubrication.

Fig. 1 will permit the details of the installation of a lubrication regulator of this kind in the machinery of a ship to be understood. The apparatus being fixed beneath the oil reservoir, at a distance that may be varied in order to obtain the pressure necessary, the oil flows first through a filter of fine-wire cloth designed to arrest all foreign bodies, and then, through the open cock, into the apparatus. Thence, by capillarity and through the wicks, *H'*, it goes through the various conduits to the collecting cups, which distribute it to the lubricators of the joints, slides, pillow blocks, eccentrics, etc. The use of this regulating apparatus presents numerous advantages: The oil undergoes no agitation, and consequently does not become oxidized. No portion of it is lost, since the quantity designed for each part is measured by the wick. The lubrication is effected automatically and is regulated by a single device for the entire engine. The regulating cup absolutely does away with the carriage of oil in cans for the filling of isolated lubricators, and permits of varying within wide limits the intensity of the lubrication either for all the parts of an engine or for certain of them that are submitted to great strain.—For the above particulars and the engravings we are indebted to La Nature.

COTTON SEED MANUFACTURE, WITH SUGGESTIONS TO INVENTORS AND ECONOMISTS.

By EDWIN LEHMAN JOHNSON.

I.

SCARCELY any product of the soil has called more often or more persistently for inventive genius than the cotton plant. Whitney's simple invention of the saw gin enabled us to make a rough separation of the fruit of the cotton plant into one part, fiber, and two parts, seed. It is not necessary to follow the one part, cotton fiber, through the marvelous steps that have evolved the modern cotton mill with its delicate machinery of almost human intelligence. The field of invention here seems almost to have reached its limit.

It is another story with the two parts of the three—cotton seed. While cotton fiber is a simple body, cotton seed is very complex. All the various operations of cotton manufacture leave the fiber practically unchanged. The woven threads in the shirt on the laborer's back are easily recognized as the same as the fibers borne on the back of the cotton seed while held aloft on its stalk in the cotton field; but out of the staple products of the cotton seed, linters (1 per cent), oil (15 per cent), meal (37½ per cent), and hulls (46½ per cent), divided in the latest manufacture into crude fiber (15 per cent) and cotton-seed grits (31½ per cent), only the linters give any indication of their source. Oil resembles red wine; meal, gold dust; the grits, ground coffee; and the crude fiber, wool.

The utilization of the cotton fiber was a problem almost wholly of mechanics. The utilization of the cotton seed has not only called into play the resources of mechanics, but of physics and chemistry as well. The hydraulic oil-press, with its beautiful simplicity, massive form and immense power, is indeed a triumph for the mechanic. So, too, is the linter, an improvement in Whitney's gin which enables it to take another bite at the lint on the seed; also the rapidly revolving hullers, without which there would have been no cotton oil industry in the United States, and the attrition mill which grinds the flint-like cakes from the hydraulic presses into meal and even flour. But without heat to convert the yielding kernels of the seed into resistant particles capable of enduring the strain upon them of the hydraulic press, without the chemical action of caustic soda in refining the oil, and, in the early days of the industry, without light to bleach it, without, at first, the field magnet and latterly the electromagnet to remove the damaging particles of iron which got into the seed, little progress would have been made in the development of the cotton seed industry and it might remain a waste product to-day, as it was for generations after cotton manufactures were well under way.

Most refractory of the products of the cotton seed have proved to be cotton seed hulls. Comprising nearly half the weight of the seed it seemed absurd to discard them and content one's self with a manufacturer's profit on the other half alone. But this is what the oil mills did, and with but one or two exceptions are doing to-day, for it long baffled the inventor to find some better use for hulls than fuel for furnaces or rough forage for cows. The simple solution of the linseed oil mills which ground the hull with the kernel and left it in the cake to make meal was not possible to the American cotton seed manufacturer, because of the oil-absorbing power of the lint-covered hull of the cotton seed. The English manufacturer, with his lintless Egyptian seed, was not troubled with the hulls, for he followed the plan of the linseed manufacturer and both these made twice as much meal as the American cotton seed manufacturer per ton of seed.

The only recourse the American cotton seed manufacturer had was to hull and separate as best he could the hulls from the kernels, press the kernels and reject the lint-covered hulls. The chemist later succeeded in burning off the lint from the seed with sulphuric acid. The mechanic has invented "delinters" without number for removing the lint from the seed before crushing, but no oil mill in the United States is successfully operating on delinted seed. For a generation the cow proved the only successful delinter, whether of the seed or the hulls, and she, with her six stomachs and the tedious process of digestion, but turned this expensive carbohydrate lint into milk and butter when cheaper food would have served as well.

The paper mill chemist has exhausted the resources of chemistry to convert crude cotton seed hulls into paper stock for his art and has given up the problem in despair.

The cows have had it all their own way with cotton seed hulls, growing fat on their half of the cotton seed, while the oil mills have been growing poor trying to make a fair manufacturer's profit out of the other half of the cotton seed, the kernels.

II.

Disappointed so often by inventions which promised far more than they performed, the oil mills view with indifference the established fact that the mechanic and chemist by combining their efforts have accomplished what neither could do alone, and that to-day not only a separate initial factory, but one of the largest oil mills, as well, is quietly turning out finished products of great value from the low-priced, comparatively worthless hulls.

The oil mills refuse to believe that anyone can point them back to first principles and show them how, by the aid of the attrition mill they knew so well, to turn two-thirds of their hulls (just as the flaxseed mills are doing) into meal, and with caustic soda, with whose use they are familiar in refining oil, how to turn the remaining third into valuable paper stock. This difficult problem has at last been fully solved. Let us turn to others.

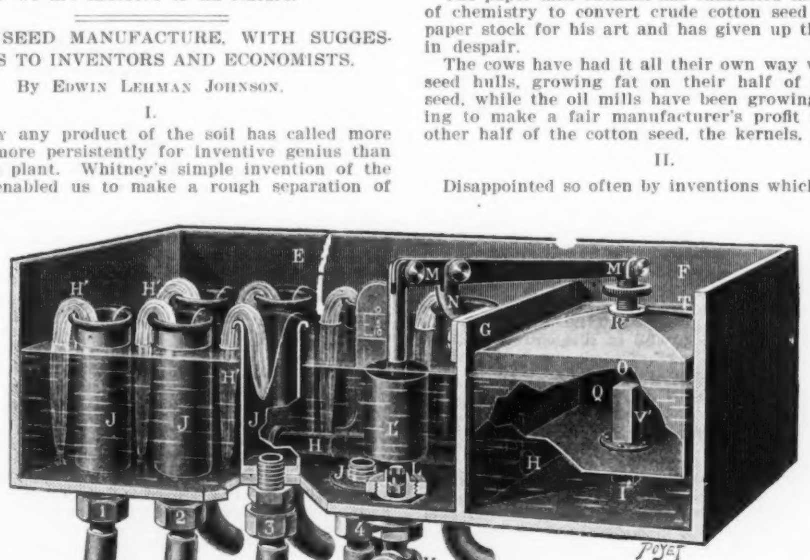


FIG. 2.—GENERAL VIEW OF THE LUBRICATING APPARATUS.

In spite of all the progress that has been made, the cotton seed is still one of the richest fields for the investigator, the inventor, the economist and the capitalist. This field is so broad, so vast and so important that, not content to invite where no invitation is needed, I *urge* upon others to enter into it, gladly welcoming any and all into the field which I have made my lifework.

Is it not strange that tens of thousands of tons of this new cereal, the cotton seed, richer in protein content, more valuable intrinsically pound for pound than wheat, should year after year undergo an injurious fermentation between the cotton patch and the press room that unfits the products of such seed for any nice use, for anything better than the soap kettle and the fertilizer factory, and makes the active period of mill operation a nightmare to the oil mill manager?

Is this fermentation only a chemical action? Is it a bacteriological change? Opinions are divided; whichever it be, who will suggest a simple and effective method of preventing or checking this fermentation when once begun? Who will do for the cotton oil industry what Pasteur did for the breweries, and change a haphazard manufacture, with its damaged and widely diverse products, into a scientific system with uniform and palatable products? The resources of government might well be applied to the task, but government turns a deaf ear to all such suggestions.

Why does the greater part, but by no means all, of the oil from cotton seed give out that penetrating odor when heated in the frying pan which has prejudiced so many housekeepers against it? Can it be removed or prevented? If neither, then who will secure the passage of a law which will foster the use of cotton oil for human food *as oil*, by requiring the inspection and the placing of such marks upon the oil offered for human food, that the householder may be able to discriminate between good and bad, and the unwise manufacturer may be prevented from hurting the sale of his own product? A fair percentage of the oil made and newly refined does not have this penetrating odor. Commercial successes have been made for a time in many large Southern cities marketing this superior quality of oil for edible purposes, but greedy and ignorant manufacturers have quickly seized the opportunity to place oil that has this objectionable quality upon the market side by side with the other, and the indiscriminating consumer has bought it, has been disgusted by the odor and has been prejudiced against all cotton oil from that time forth.

In our Southeastern states there are rigid laws authorizing, protecting and inspecting cotton seed meal offered for sale as plant food (fertilizer), but in no state is there a law authorizing, protecting or inspecting cotton oil offered for sale as oil for human food. In no agricultural college is cotton oil used for food, nor is there any record so far as I can find of any test or experiment of using cotton oil for human food by any of our agricultural experiment stations, nor any bulletin which teaches the public that a considerable proportion of cotton oil as manufactured to-day is not only entirely unobjectionable as an edible fat, but is actually the best and most economical fat in the world for human food. No bulletin teaches how to discriminate the small portion of oil that is good for food from the much larger proportion which is unfit for food. Yet we find more than one costly bulletin advocating the use of that luxury, the mushroom, for food, and with painstaking care illustrates the many varieties, and teaches how to distinguish the wholesome from the noxious.

We find that linseed oil (of all oils) has been used successfully abroad to supply the place of butter fat in the skim milk for calves, yet many of our American dairy authorities advocate knocking the poor calf in the head rather than raise it on the expensive milk which greedy man stands ready to buy out of its mouth. Why not replace the but. r fat with cotton oil and let the poor calf live? Surely oil at 4 cents per pound can be economically fed if butter fat at 25 cents per pound cannot.

III.

Coming down to the ground in this cotton seed industry, there is urgent need of some simple device or system for testing or classifying cotton seed, so that a proper valuation may be placed upon seed, and the different qualities separated and manufactured differently. The too common practice of taking all seed that comes dirty, trashy, sandy, heated or half-rotten and dumping it into a single big shed without any, or at best, only a superficial examination must cease.

The use of cotton seed meal as an ammoniate in commercial fertilizer while at present a necessity is one of these too common instances of American want of thrift and unsound economy. No fact of agricultural chemistry has been demonstrated more thoroughly than that 90 per cent of the fertilizing value of cotton seed meal is excreted by cattle fed upon it. The true economy is first to feed, and then to fertilize with this exceedingly rich manure. That this would some day be done generally by intelligent farmers is a dream I once had which has been dissipated by hard experience. The almost universal practice of the farmer is to apply manure four tons or more to the acre, furnishing each acre of ground 90 pounds of ammonia, when one-tenth as much, or 9 pounds, is considered a liberal allowance in commercial fertilizer. If the remarkable success of commercial fertilizers in Georgia and the Carolinas has taught anything at all, it is that manures should be dried, ground and applied repeatedly in small quantities. The application of four tons or more of manure per acre is ricidulously extravagant.

This business will resolve itself in the near future into the farmers raising the cattle, the oil mills purchasing them half fat at a good price, fattening them for three to six months, saving, drying and grinding the manure and selling it to the fertilizer factories as an ammoniate instead of cotton seed meal. The portion of manure dropped by the cattle on the farm will not be sufficient with all the "bedding" added to it to keep the land in "humus," without whose presence in the soil it does not pay to use commercial fertilizer. The idea which seems to dominate the fertilizer interests, as well as too many of our agricultural colleges, that there is a conflict of interest between home-made manure and commercial fertilizer, is utterly erroneous and stands much in the way of the cotton seed's true progress. Both the agricultural college and the fertilizer interests seem negligent of the great importance to them as well as to the South of immediately and greatly increasing the number of cattle in the Southeastern states, and this indifference can be due to nothing else but this foolish opposition to home manures. This shows a lack of analytical thought and reasoning to a conclusion which at the least seems remarkable. There is much work for both the inventor and the economist in this department of the cotton seed industry.

Of late years the cotton oil industry has been widely scattered throughout all the cotton-growing states far in the interior, from North Carolina to Texas. It was found that men of ordinary intelligence and ability could conduct successfully small oil mills upon the simple lines laid down by the older and larger concerns. These latter, instead of keeping ahead of the procession, instead of differentiating and expanding their work, instead of following economic and scientific principles, have made very little progress in ten years, and have of late grown thoroughly alarmed at the inroads which the smaller mills have made upon their seed supply. Having neglected their opportunities in the past to keep ahead of the smaller mills, they seem to be now imbued with a fear that the true economic utilization of the cotton seed will help the interior mills at the expense of the larger and more central ones. This is most unwise. No manufacture can long afford to neglect the true interests of the people upon whom it is dependent for its raw product.

New inventions are more readily taken up and more easily put into practical commercial use by the larger companies, and a careful study of the subject convinces me that the best interests of these companies lie in giving all possible encouragement to the inventor and the economist.

Of the advantage to the entire cotton seed interest, manufacturing as well as agricultural, of the adoption of true economic methods in handling the cotton seed there can be no manner of doubt; yet it is a superhuman task to impress this fact upon the farmer, while patience and persistence are needed to make an impression upon the three or four hundred scattered, independent oil mill men who are well-nigh as suspicious and hard to reach as the farmers themselves.

If some amiable and intelligent despot were in charge of the cotton seed interest throughout, from plantation to the last product, and would conduct the entire business in all its departments upon sound economic principles, there would not only be as great earnings as at present to divide, but a clear saving additionally of $200,000,000 a year.

TRADE NOTES AND RECEIPTS.

Smelling Salt.—Fill small glasses having ground stopper with pieces of sponge free from sand and saturate with a mixture of spirit of sal ammoniac (0.910) 9 parts and oil of lavender 1 part. Or else fill the bottles with small dice of ammonium sesquicarbonate and pour the above mixture over them.—Drogistische Rundschau.

Liquid Blue for the laundry is prepared by dissolving 8.3 grammes of indigo in 33.3 grammes of fuming sulphuric acid, diluting the solution with 2 liters of water. Next neutralize with chalk and finally filter.

Another process consists in making a thinly liquid mixture by stirring ultramarine powder in lime water of 2 per cent.—Farben Zeitung.

For the Purpose of Removing Spots from Tracing Cloth it is best to use benzine, which is applied by means of a cotton rag. The benzine also takes off lead-pencil marks, but does not attack India and other ink. The places treated with benzine should subsequently be rubbed with a little talcum, otherwise it would not be possible to use the pen on them.—Kraft und Licht.

Lustrous, Blue-black, Permanent, Rust-Preventive Layer on Iron.—To produce such a covering, Ph. Hess recommends the use of copper sulphide. The well-cleaned iron parts are suspended for a few minutes in a blue-vitriol solution, so that a delicate skin of copper forms on the surface; if the pieces rinsed off with water are then moved about for a few minutes in a solution of sodium hyposulphite faintly acidulated with hydrochloric acid, they assume a blue-black coating of copper sulphide, which is known to be equally permanent in the air and in water. The black surface may be immediately rinsed off with water, dried off with a rag or blotting paper, and polished at once with a polishing stick. It possesses a steel-blue luster, adheres well to the iron, will stand treatment with the scratchbrush, and protects against rust in a most satisfactory manner.—Wiener Metallarbeiter.

To Fix Iron in Stone.—Among the binding agents, which are used for fixing iron bolts, grate-bars, etc., in stone, Portland cement has heretofore been given the preference, since it possesses the greatest strength and the property of counteracting the rusting of iron. Only the long time consumed in hardening is a drawback. Of the quickly hardening cements, lead and sulphur, the latter is popularly employed. It can be rendered still more suitable for purposes of pouring by the admixture of Portland cement, which is stirred into the molten sulphur in the ratio of 1 to 3 parts by weight. The strength of the latter is increased by this addition, since the formation of so coarse a crystalline structure as that of solidifying pure sulphur is disturbed by the powder added. The mixture has a gray, metallic color.—Uhland's Technische Rundschau.

Celluloid Varnish.—Celluloid varnishes, solutions of celluloid in certain liquids, differ from the other varnishes chiefly in that they do not give much gloss if applied to paper, fabrics, wood, etc., while bright metals, glass, etc., retain their entire luster. While all varnishes containing resins are noticeable at once and produce vivid iridescence on bright metals, the celluloid varnishes are not perceptible and no irized colors appear. Moreover, they adhere very strongly to the material and cannot, especially on metals, be removed by scratching, in spite of the varnish being soft and elastic. The varnish is applied by simply pouring it on the articles or by dipping them in the liquid. No laps, drops, spots, etc., form, the coatings dry very quickly, the appearance never changes, the gloss never diminishes; in short, for a large number of purposes the celluloid varnishes are excellently adapted.—Deutsche Celluloid Industrie.

Restoring the Original Color to Old Parquet Floors.—In order to restore to old parquet floors of oak or other wood, which have acquired a dark color or are full of dirt, the original color, or to render them still lighter, the Munich Maler Zeitung gives the following directions: Boil 1 part of calcined soda for 45 minutes with 1 part of slaked lime and 15 parts of water in a cast iron pot. The caustic soda thus obtained is spread on the floor by means of a cloth attached to the end of a stick. Some time after, rub the floor with a hard brush and fine sand, as well as a sufficient quantity of water, to remove the old wax and all impurities. Next make a mixture of 1 part of concentrated sulphuric acid and 8 parts of water and spread this on the floor. The sulphuric acid revives the color of the wood by combining with the brown substance and the earthy particles which have entered. When the floor has dried again, it is once more scoured with water, whereupon it is waxed as customary after drying anew. If any spots have remained behind this is a proof that the floor after the application of the caustic soda lye has not been rubbed evenly throughout. These spots have to be treated again with soda lye and sulphuric acid in the manner stated.

Improvement in the Preparation of Stucco.—The object of the present process is the production of a stucco which is weather-proof and at the same time of good appearance.

In order to attain this end mix powdered chalk, about 70 parts, with dextrine 10 parts, about 5 per cent of potato flour and 5 per cent of unslaked lime. After these various ingredients have previously been stirred to a paste with cold water, and thoroughly boil this mixture with addition of wadding, linen fibers, etc.

During the boiling add non-saponifiable oils or fatty substances, e. g., petroleum, paraffine, etc., also a little turpentine or varnish. The object of the last-named admixtures is to impart to the mass great resisting power to atmospheric actions, especially to the absorption of moisture, hence to preserve it from decay. Another result is that the mass, owing to the presence of grease, readily enters the finest parts of the molds and can be removed from the molds in a smooth condition, whereby the surface of the molded article can be kept free from blisters and the most minute elevations and cavities of the mold come out perfect.

The stucco obtained in the described manner resembles in its fine elaboration that made of gypsum, but has the advantage over the latter of being weather-proof.—Neueste Erfindungen und Erfahrungen.

Sifting Without a Sieve.—Sifting without a sieve, as reported in Kirchhoff's Technische Blaetter by Prof. Kick, of Vienna, is a process by which dust like layers can be separated from coarser ones without the use of a sieve or the aid of moving air or water.

The material to be sifted or separated is thrown in the upper part of a die-shaped box by a rapidly rotating brush in a fine division against smooth cylinders likewise rotating. The horizontal axes of these cylinders, which do not touch, are situated in a plane which to the horizontal includes the angle of about 80 deg. The rollers make 200 revolutions per minute and the very fine particles remain adhering to them while the coarser ones are thrown off. If the cylinders were caused to make 150 revolutions instead of 200, particles of lesser fineness would also remain clinging to them; the action would be similar if the rollers were made rough instead of smooth.

Since all the rollers turn in the same direction, the coarse particles are thrown off on one side of the cylinders while the fine ones are taken along to the other side, where they are scraped off. This new separation method has been invented by G. and A. Cusson Frères, of Chateauroux (Indre), France, and is especially adapted for the separation of powders which are so fine that sieves do not separate them any more.

Cusson's machine, says the above journal, will be of especial value where the separation used to be effected by levigation and may partly take the place of elutriation.

Bay Rum.—1. Bay oil, 15.0; sweet orange oil. 1.0; pimento oil, 1.0; spirit of wine, 1000.0; water, 750.0; soap spirit or quillaya bark, ad libitum.

2. Bay oil, 12.5; sweet orange oil, 0.5; pimento oil, 0.5; spirit of wine, 200.0; water, 2,800.0; Jamaica rum essence, 75.0; soap powder, 20.0; quillaya extract, 5.0; borax, 10.0; use sugar color.

3. Bay oil, 16 parts; clove oil, 1 part; pimento oil, 1 part; Jamaica rum essence, 75 parts; spirit of wine, 2,650 parts; water, 1,850 parts. Mix and filter.

4. Mix. Tinct. Pimentæ acris (1:10) 600.0; spirit (95 per cent), 500.0; bay oil, 10.0; pimento oil, 1.0; sweet orange oil, 1.0, and after three days add distilled water, 800.0. Filter a week later. The Tinct. Pimentæ acris is produced from genuine bay leaves by means of high-strength spirit.

5. Mix 1 kilo of 95 per cent spirit and 14 grammes of bay oil and allow to stand for two weeks, then add 2 kilos of Jamaica rum essence.

6. Mix 200 grammes of alcohol, 1 gramme of bay oil, 10 drops of pimento oil and 1 of clove oil, and add 200 grammes of water.

7. Bay oil, 3.75; pimento oil, 3.75; acetic ether, 7.50; alcohol, 13,500; distilled, 11,750; dye brownish yellow.

8. Spirit (95 per cent) 1,100 grammes, warm water 4 grammes, Venetian oil-soap 30 grammes. Dissolve in 460 grammes of warm water. Jamaica rum essence, 60 grammes; bay oil, 6 grammes; clove oil, 4 grammes; absolute alcohol, 30 grammes; cinnamon oil, 1 gramme.

9. Dissolve 70 grammes of genuine bay oil and 200 grammes of Cachaça essence in 10 kilos of 95 per cent spirit and concentrate by shaking 3 kilos of rose water (triple), and add 5 kilos of water. After the whole has been intimately mixed allow to rest for 1 to 2 days and filter. A second grade can be produced by substituting ordinary water for the rose water.—Pharmaceutische Zeitung.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Industrial Development in Japan.—Although the Japanese have for several centuries been engaged in mining operations and have exported large quantities of copper and other metals, the iron mines of the country have remained undeveloped, while each year the imports of pig iron and of manufactured iron and steel goods have been very large. The following table shows the amounts imported, with values, for the past three years:

Year.	Quantity.	Value.
1898............	362,340 tons	$9,706,668.51
1899............	196,255 tons	7,703,937.50
1900............	342,941 tons	15,769,107.60

The above does not include the expenditures of the government for war vessels and arms, which in 1900 amounted to $8,345,993.70 and during the past ten years has aggregated $65,197,772.21.

During 1898 the output of iron from all the mines in Japan amounted to 26,234 tons, this being a little less than for each of the three preceding years, but more than for any year previous to 1895. The figures for 1899 and 1900 are not available.

It is believed that there are rich deposits of iron ore in northern Japan, Dr. Noro having estimated that there are deposits to exceed 75,000,000 tons within a radius of 60 miles from Ofunato. The ore is found in beds and veins, and contains a very large percentage of iron. The same district contains considerable amounts of sulphur and copper and some lead. The reasons assigned for the non-development of these mines are: (1) Want of mining and engineering experience; (2) failure of the work started by the government in 1876 (owing to insufficient fuel for charcoal pig), which discouraged others from undertaking it; (3) the general economic depression now prevailing in this country.

Viscount Enomoto, retired Rear-Admiral of the Imperial Japanese navy, and Mr. Amenomiya have recently started a company known as the Ofunato Railway, Harbor Improvement, and Iron Works Company, Limited, having for its object the development of these mines. Their project includes the improvement of Ofunato Harbor (which is said to possess excellent natural conditions and is on the eastern coast a little more than half-way from Tokyo Bay to the northern extremity of the island), the construction of 60 miles of railroad to connect the harbor with the main line of the Nippon Railway, the purchase and development of mines, and the building of an iron and steel foundry, machine shops, etc.

For this work they wish to raise a capital of 12,000,000 yen, or $5,976,000, to be used as follows:

	Yen.	
For construction of the harbor..	1,500,000 =	$747,000
For construction of the railway..	6,000,000 =	2,988,000
For iron and steel works........	4,000,000 =	1,992,000

They are anxious to secure the aid of foreigners in carrying on the enterprise, and to this end are willing to give aliens the opportunity of becoming stockholders, showing in this respect a more liberal spirit than the Japanese are usually credited with.

At present Yokohama is the most northerly harbor on the eastern coast of the principal islands of the Empire, and the promoters are convinced that Ofunato Harbor, with good railroad connections—such as their plan provides for—would become the center of an extensive commerce, which could not fail to yield a fair profit independently of the iron industry, and if sufficient capital can be procured they believe the iron industry can now be successfully undertaken, the other hindrances to its success having disappeared. Coal well suited for this work can now be obtained abundantly within easy reach of the proposed plant.

The investment of foreign capital in such enterprises has hitherto been greatly discouraged by the Japanese laws, which made it impossible for foreigners to own land, and placed restrictions on their business operations that greatly increased the risks and decreased the profits of their investments. The mining laws have lately been amended so as to be much more favorable to foreign investors, and the hope is held out that within a few months the right to own land may be conferred on aliens. A writer in The Japan Times of April 28 is authority for the statement that by indirection aliens may even now become landowners. He says:

"Japanese law allows what is known as the juridical person—a species of fiction by means of which foreigners can, in a sort of side way, own land. This juridical personage, to whom attaches the right of owning land, must consist of two or more persons. A man and his wife can become a juridical person. In case of A and B, who have become a juridical person, if one died and the place is not filled within a specified time, the property or the undertaking would be sold."

In this connection, the following résumé of an article which appeared in The Japan Daily Herald of May 31 may be of interest:

The Japanese Imperial Government, desiring to make the country independent of foreign aid in shipbuilding, railway construction, and the supply of military and naval requisites, has commenced work on a steel establishment, for which the government treasury has appropriated $7,056,425. The works will cover an area of 225 acres, and lie close to the shore on an excellent harbor in the northern part of Kyushu, ten miles distant from Moji. The grounds are connected by a branch line with the principal Kyushu Railway, and are situated close to rich coal fields. There will be three departments, each under the joint direction of two engineers, one Japanese and one foreign. The pig-iron department will be fitted with coke-oven and blast-furnace plants, the steel department with mixed Bessemer and open-hearth plants and a steel foundry, and the rolling-mill department with roughing-rail mill, large, middle, and small bar mills, sheet mill, and large and middle plate mills—this department including seven sub-departments. It is intended to fit each department with all needed appliances for doing the best work. About one-third of the appropriation has already been expended, but the time when the works shall go into operation is not named.

An iron foundry at Fukuoka, under the direction of Mr. Wada, is said to be very successful, and is turning out 100 tons of pig iron per day; and there are some very successful shipbuilding plants, but it is now necessary to import much of the raw material, and some of the fittings are manufactured abroad. The government has also lately opened an iron foundry at Wakamatsu, imported a large blast furnace, and expects to turn out about 120,000 tons of cast iron per year.

Many undertakings requiring the use of thousands of tons of iron are being held in abeyance, awaiting the dawning of better times, or the influx of foreign capital. If this can be secured, there will be no question of an active market for all the iron the country can produce.

A Japanese company has already been intrusted with the construction of a railroad in Korea, and the Japanese are ambitious to become the center of supply for China and other Oriental countries.—E. C. Bellows, Consul-General at Yokohama.

United States Trade with Germany.—Ambassador White, of Berlin, under date of July 2, 1901, transmits the following official statistics of the foreign trade of Germany from 1891 to 1900, inclusive:

In 1891 the United States occupied fourth place in the import trade of Germany, with a total of $108,528,000, being preceded by Great Britain, with $160,888,000; Austria-Hungary, with $142,324,000; and Russia, with $138,040,000. In 1895 the imports into Germany from the United States rose to $121,618,000, and after that year increased rapidly until 1900, when they reached the sum of $266,750,400. The United States thus stands far above any other country in this trade, being followed by Great Britain, with $199,920,000; Russia, with $173,740,000; Austria, with $172,312,000; and France, with $72,590,000. During this period, American imports into Germany have increased more than those of the last-named four countries together. As regards the export trade of Germany, the United States has occupied third place during this whole period. In 1900 the United States imports from Germany were to the value of $104,482,000; in 1899, $89,726,000; and in 1898, $79,492,000. Up to 1898 they showed a tendency to decline, amounting in 1891 to $84,966,000, and sinking in 1894, under the tariff of 1890, to $64,498,000, the lowest point reached. The first place in the export trade has been continually held by Great Britain (which is the only large country with which German trade shows larger exports than imports), the second is held by Austria-Hungary, and the fourth by Holland, though from 1896 to 1899, inclusive, this was held by Russia, which is now fifth. Within this period—1891-1900—there have been notable increases in Germany's exports to England (notwithstanding that since 1897 there has been no commercial treaty between these countries), to Belgium, Italy, Sweden and Norway, British India, Australia, China, and Denmark. The greatest relative increase has been in the exports to Japan, which have risen from $3,332,000 in 1891 to $16,660,000 in 1900.

New Lines of the Hamburg-American Steamship Company.—It is reported on good authority that four new lines are to be incorporated with the Hamburg-American Line:

(1) The "Jebsen" Line, between Shanghai and Tsintau. This line was subsidized by the German government; it is proposed to enlarge the service and extend it to Chefoo and Tientsin, the Hamburg-American Line wishing to gain part of the Chinese shore trade.

(2) The share held by the Bremen firm of Rickmers in a line operated on the Yangtze by the North German Lloyd. It is expected that the Yangtze commerce will soon increase greatly. The North German Lloyd and the Hamburg-American Line in this case work together.

(3) The third project is that of a regular East Asia and San Francisco route, by which (using the overland route between San Francisco and New York) a more rapid communication with the East will be secured than via the Suez Canal.

(4) The fourth enterprise is the purchase of the British Atlas Line, operating between New York, the West Indies, and South America.—Richard Guenther, Consul-General at Frankfort.

Congress of Historical Sciences at Rome.—The Department has received a note from the secretary of the Italian Embassy, Mr. Carignani, dated Washington, July 24, 1901, in regard to the International Congress of Historical Sciences to be held in Rome in the spring of 1902. The promoting committee asks that the government of the United States send delegates to the congress, and invites the participation of American scientists, artists, and men of letters. The congress will include all subjects of an historical character. The principal sections will be the following:

"(1) Classical archæology; (2) numismatics; (3) history of oriental and classical antiquity; (4) history of ancient literature; (5) history of ancient law; (6) mediæval and modern, general and diplomatic history—diplomatic and archivistic science; (7) history of mediæval and modern literature; (8) history of mediæval and modern art; (9) history of modern law; (10) history of economical and social science; (11) history of philosophy and of pedagogy; (12) history of religion; (13) history of geographic exploration and discovery—historical geography; (14) history of mathematical, physical, natural, and mediæval science; (15) history of musical and dramatic art; (16) teaching of history."

The programme of exercises has not yet been definitely decided; suggestions for themes will be received until January, 1902. Persons desirous of taking part in the congress will send their names either to the president of the Executive Committee or to the general secretary, via dei Greci n. 18, Roma, with the membership fee of 12 lire ($2.32), indicating the section in which they wish to be inscribed.

Conditions in Dawson.—Dawson is improving rapidly; modern dwellings and warehouses are going up, a new court house is about completed, and work has been started on the new administration buildings and a residence for the Governor.

Notwithstanding the long, cold winter, there was a continual flow of pure water from a well sunk on the bank of the Klondike River. The water is pumped direct into the mains from the well, under such pressure that the pipes are kept open. Taps are located on the sidewalks all over the city.

Ice costs only 2 cents per pound, or $40 a ton, the lowest price this luxury has been in any summer yet. Rents are not lower, but in the near future they will probably be reduced.

The gold output will, it is said, fall short of the estimate made earlier in the year, one reason being the long winter. I think $20,000,000 a fair estimate for this year's product. Many of the richest claims have not yielded as much this season as formerly. While there is a very large gold-bearing area in this territory, the miners must learn to work more economically.

On the Hootalinqua River and at other points there are good indications, but the prospectors will not go there yet, as the grounds are too far away from a base of supplies. After the placer mines near Dawson are worked out—say, in ten years—the attention of the miners will be turned to fields in this territory not yet opened up.

By orders from Ottawa, the whole country has been thrown open for prospecting, no claims being reserved for the Crown, as formerly.

The royalty on the gross output of the mines has been reduced from 10 per cent to 5 per cent.

In taking gold out of the state, a certificate from the gold commissioner is required, stating that the royalty has been paid thereon. This is given to the police at White Horse before one is allowed to leave on the train for Skagway. Without this certificate the dust is liable to confiscation.

The government is building good roads to the mining sections near Dawson, which will be of great advantage to the operators, as their supplies can be handled at less cost. Good roads are badly needed in the mining country in Alaska.

Encouraging reports are heard from Chandlar River in Alaska, some 100 to 150 miles north of Fort Yukon; also from Charley River and other points. When the miner can get his supplies at reasonable rates it will be found how rich this part of Alaska is.—J. C. McCook, Consul at Dawson City.

Australian Cable Soundings.—The British cable steamer "Britannia" arrived on the 12th instant from Brisbane, Queensland, her work being to mark out a track for the new Pacific cable. On the passage across from Australia, soundings were taken every 10 miles. About 100 miles from the coast an obstruction was met with, a mountain or range of mountains coming right in the track, and a slight deviation south had to be made in order to clear it. Two thousand eight hundred fathoms was the greatest depth obtained, and 257 fathoms the shallowest, on top of the mountains referred to. It has been decided that Anson Bay, on the west side, is the best place to land the cable here. Anson Bay is 6 miles from the settlement of Kingston. A cable house is to be built close to the shore in the bay.

Norfolk Island will be one of the most important stations, as all messages to Australia and New Zealand will converge here, to be repeated. The Australian and New Zealand portion of the line will, it is stated, be completed by the middle of next year; the other portion, by the end of 1902.

The "Britannia" sailed for Auckland, New Zealand, to-day, and will take soundings on the passage; she is expected to return in three or four weeks, and to depart for Fiji on a like errand.—Isaac Robinson, Consular Agent at Norfolk Island.

Spanish Demand for Artificial Manures.—Consul-General Hughes, of Coburg, under date of August 1, 1901, says that, according to newspaper reports, the development of beet production in Spain has created such a demand for artificial manures that Spanish dealers find it very difficult to fill contracts. Valencia alone imports from England 50,000 tons of sulphate of ammonia, 8,000 tons of superphosphate, and 20,000 tons of dark-gray saltpeter. Sulphates of ammonia are mostly in demand; they usually contain from 24 to 25 per cent of ammonia, or 20 to 21 per cent of nitrogenous matter. A large increase in the demand for artificial manure from the Canary Islands is also noted, England furnishing the greater part. Sulphate of ammonia, superphosphate, and nitrate of soda are principally imported into these islands. Mr. Hughes thinks that American exporters might secure the greater part of this market, if they would send people to look after it.

Rubber in French Africa.—Mr. Thieriot, chargé at Lisbon, sends, under date of July 18, 1901, translation of an article in a local journal, from which the following extract is taken: "Explorations in connection with the production of rubber began in Madagascar in 1851, and have of late years increased to a notable extent. M. Jamelle recently called attention to the 'piralahy,' a new shrub of the genus *Landolphia*, which is found in the forests of Bueni, in Majunga, in Andriba, and in the valley of Betisbooka. In the French Kongo, also, a few apocyneous plants of the genus *Landolphia* are met with, which yield a quantity of india rubber. The amount produced is estimated at 500 tons per annum. The whole country, says M. Savorgnan, is literally covered with rubber trees. The yield in Senegal is small at present. The aborigines are just beginning to bring into the market a clear substance called kurussa, whose commercial value closely approximates that of the rubber of Para."

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

To Clean Lacquered Goods.—Papier maché and lacquered goods may be cleaned perfectly by rubbing thoroughly with a paste made of wheat flour and olive oil. Apply with a bit of soft flannel or old linen, rubbing quite strongly; wipe off and polish by rubbing with an old silk handkerchief.

Insect Destroyers.—A roach poison which is practically harmless to man, may be made by the following formula:

Borax	9 ounces
Starch	2½ ounces
Cocoa	1 ounce

Another preparation not so inactive as to human beings is made by mixing:

Angelica root, in fine powder	5 ounces
Oil of eucalyptus	1 ounce

Scatter at night plentifully around the haunts of the pests.

The well-known insect powder obtained by grinding the flowers of certain pyrethrums is also an excellent agent for the destruction of roaches, but not quite so convenient to use as the foregoing. The observations of some experimenters seem to show that the poisonous principle of these flowers is non-volatile, but our experience indicates that these observations are not complete, as the most favorable conditions under which to use them are in a room tightly closed and well warmed. There may be two poisonous principles, one of which is volatile. Disappointment sometimes arises in its use from getting powder either adulterated, or which has been exposed to the air and consequently lost some of its power. When a good article is obtained and used plentifully under the conditions above indicated, it proves very efficient.

An objection to the foregoing method is the great dust which it makes. This dust sometimes proves irritating to the mucous membranes of the one applying the powder, and also makes a "mess" in the room. To avoid this, it has been made into a tincture and applied by means of a spray atomizer, with alleged good results.

We would add that persistence in the use of any means is an important element in the work of destroying roaches. A given poison may be employed and no visible result follow at first, when in reality many bugs may have been destroyed, enough being left to deceive the observer as to numbers. They multiply very rapidly, too, it must be remembered, and vigorous work is required to combat this increase. Where they can easily migrate from one householder's premises to those of another, as in city "flats," it requires constant vigilance to keep them down and entire extermination is scarcely to be expected.

A fly poison which is harmless to man may be made from quassia wood as follows:

Quassia	1,000 parts
Molasses	150 parts
Alcohol	50 parts
Water	5,750 parts

Macerate the quassia in 5,000 parts of water for 24 hours, boil for half an hour, set aside for 24 hours, then press out the liquid. Mix this with the molasses and evaporate to 200 parts. Add the alcohol and the remaining 750 parts of water, and without filtering, saturate absorbent paper with it.

This being set out on a plate with a little water attracts the flies, which are killed by partaking of the liquid.

Insect powder is said to be an effective destroyer of ants, as it is of beetles. Ground mustard accidentally spilled on the floor of a pantry and allowed to remain for some time drove ants away. Sulphur is said to prove similarly distasteful to them. Oil of cedar and coal oil also drive them away. Borax would probably prove fatal to ants, if they could be induced to eat it. This might be accomplished by mixing it with sugar; or they might be attracted by the cocoa mixture, a formula for which is given above.

Where ants select a particular point for their incursions it would be a good plan to surround it with a "fortification" of obnoxious substance. Sulphur, mentioned above as being distasteful to them, has been used successfully in this way, we are told; and so has coal oil. The latter, however, is not a desirable agent, leaving a persistent stain and odor.

In the extermination of ants, as of roaches, persistence is a factor of great value, and failure of agents which have been proved useful elsewhere may be due to a want of this factor.

The United States Department of Agriculture has published some formulas for insecticides with especial reference to vermin which attack plants. Two of these are here given:

Kerosene	2 gallons
Common soap	½ pound
Water	1 gallon

Heat the solution of soap, add it boiling hot to the kerosene and churn until it forms a perfect emulsion. For use upon scale insects it is diluted with nine parts of water; upon other ordinary insects with fifteen parts of water, and upon soft insects, like plant lice, with from twenty to twenty-five parts of water.

For lice, etc., which attack the roots of vines and trees the following is recommended:

Caustic soda	5 pounds
Resin	40 pounds
Water, a sufficient quantity.	

Dissolve the soda in four gallons of water by the aid of heat, add the resin and after it is dissolved and while boiling add, slowly, enough water to make fifty gallons. For use one part of this mixture is diluted with ten parts of water and about five gallons of the product poured into a depression near the root of the vine or tree.—The Druggists' Circular.

Iron Pipes for Roumania.—Consul-General Guenther, of Frankfort, July 24, 1901, says that the Chamber of Commerce of Mülheim-am-Ruhr, Germany, has petitioned the authorities to reduce the railroad rates on iron pipes for export to Roumania, so that local manufacturers will be enabled to meet American competition.

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